**Question 1**

$A=15.25\_{10}$ in binary $1111.01\_{2}=1.11101\*2^{3}$

$S\_{A}=0 +v\_{e}$ , $e\_{A}=bias+3=01111111+00000011=10000010$

$$m\_{A}=11101000\rightarrow 0$$

Representation of A

23 bits

|  |  |  |  |
| --- | --- | --- | --- |
| A= | 0 | 10000010 | 111010…0 |

$B=-0.25\_{10}$ in binary $-0.01\_{2}=-1.0\*2^{-2}$

$S\_{B}=1 -v\_{e}$ , $e\_{B}=-2+127=01111111+11111110=01111101$

$$m\_{B}=0000\rightarrow 0$$

Representation of B

23 bits

|  |  |  |  |
| --- | --- | --- | --- |
| B= | 0 | $$01111101$$ | 000000…0 |

Comparison of exponents: $e\_{A}>e\_{B}$

Difference of exponents:$ e\_{A}-e\_{B}=10000010-01111101=00000101$

 $=10000010+00000011 =00000101$

shift smaller operand by $00000101=5\_{10}$ to the right

$$m\_{B}=1.00000\rightarrow \*2^{-5}=0.0001$$

$$-m\_{B}=1.1110+1=1.1111$$

Now A

$$m\_{A}+m\_{B}=1.11101+\left(-0.00001\right)=001.11101+111.1111=01.11100$$

$$m\_{result}=01.111000…0\*2^{3}$$

Normalization$ \rightarrow $ not required Subtraction

Rounding $\rightarrow $ not required $R\left(M\_{0}+S\right)=0$

$∴e\_{R}=e\_{A}=10000010$

|  |  |  |
| --- | --- | --- |
| 0 | 10000010 | 11100000…0 |

 $m\_{R}=111000\rightarrow 0$

$$ S=0 (+ve)$$

23 bits



$$m\_{B}$$

$$m\_{A}$$

$$e\_{B}$$

$$e\_{A}$$

$$S\_{A}$$

$$S\_{B}$$

$$m\_{R}$$

$$e\_{R}$$

$$S\_{R}$$

**Question 2**

Use  to produce partial products

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | $$X\_{3}$$ | $$X\_{2}$$ | $$X\_{1}$$ | $$X\_{0}$$ |
|  |  |  |  | $$X\_{3}$$ | $$X\_{2}$$ | $$X\_{1}$$ | $$X\_{0}$$ |
|  |  |  |  | $$X\_{0}X\_{3}$$ | $$X\_{0}X\_{2}$$ | $$X\_{0}X\_{1}$$ | $$X\_{0}X\_{0}$$ |
|  |  |  | $$X\_{1}X\_{3}$$ | $$X\_{1}X\_{2}$$ | $$X\_{1}X\_{1}$$ | $$X\_{1}X\_{0}$$ |  |
|  |  | $$X\_{2}X\_{3}$$ | $$X\_{2}X\_{2}$$ | $$X\_{2}X\_{1}$$ | $$X\_{2}X\_{0}$$ |  |  |
|  | $$X\_{3}X\_{3}$$ | $$X\_{3}X\_{2}$$ | $$X\_{3}X\_{1}$$ | $$X\_{3}X\_{0}$$ |  |  |  |
|  | $$X\_{3}X\_{2}$$ | $$X\_{1}X\_{3}$$ | $$X\_{0}X\_{3}$$ | $$X\_{0}X\_{2}$$ | $$X\_{1}X\_{0}$$ | 0 | $$X\_{0}$$ |
|  | $$X\_{3}$$ |  | $$X\_{2}X\_{1}$$ |  | $$X\_{1}$$ |  |  |
|  |  |  | $$X\_{2}$$ |  |  |  |  |

$$0$$

$$X\_{1}X\_{3}$$

$$X\_{2}X\_{1}$$

$$X\_{2}$$

$$0$$

$$X\_{1}X\_{0}$$

$$X\_{0}X\_{2}$$

$$X\_{1}$$

$$0$$

$$X\_{0}$$

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

$$0$$

$$X\_{0}X\_{3}$$

$$0$$

$$X\_{3}X\_{2}$$

$$0$$

$$0$$

$$X\_{3}$$

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

$$P\_{7}$$

$$P\_{6}$$

$$P\_{5}$$

$$P\_{4}$$

$$P\_{3}$$

$$P\_{2}$$

$$P\_{1}$$

$$P\_{0}$$

$$Delay=8FA+1 AND$$

if X is a 2’s complement number, than we have to convert the number as follows:

$$X\_{2}$$

$$X\_{1}$$

$$X\_{0}$$



$$X\_{3}$$

0

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

0

0

$$N\_{3}$$

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | $$N\_{2}$$ | $$N\_{1}$$ | $$N\_{0}$$ |
|  |  | $$N\_{2}$$ | $$N\_{1}$$ | $$N\_{0}$$ |
|  |  | $$N\_{0}N\_{2}$$ | $$N\_{0}N\_{1}$$ | $$N\_{0}N\_{0}$$ |
|  | $$N\_{1}N\_{2}$$ | $$N\_{1}N\_{1}$$ | $$N\_{1}N\_{0}$$ |  |
| $$N\_{2}N\_{2}$$ | $$N\_{2}N\_{1}$$ | $$N\_{2}N\_{0}$$ |  |  |
| $$N\_{1}N\_{2}$$ | $$N\_{2}N\_{1}$$ | $$N\_{1}N\_{0}$$ | 0 | $$N\_{0}$$ |
| $$N\_{2}$$ |  | $$N\_{1}$$ |  |  |

$$N\_{1}N\_{0}$$

$$N\_{1}$$

0

$$N\_{0}$$

$$N\_{2}$$

$$N\_{1}N\_{2}$$

0

$$N\_{2}N\_{1}$$

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |

$$0$$

$$0$$

$$P\_{5}$$

$$P\_{3}$$

$$P\_{2}$$

$$P\_{0}$$

$$P\_{1}$$

$$P\_{4}$$

**Question 3**

State diagram:



State table:

|  |  |
| --- | --- |
| Present State | Next State |
| $$C\_{1}$$ | $$C\_{2}$$ |
| $$C\_{2}$$ | $$C\_{3}$$ |
| $$C\_{3}$$ | $$C\_{4}$$ |
| $$C\_{4}$$ | $$C\_{1}$$ |

State assignment:

$C\_{1}=00$, $C\_{2}=01$, $C\_{3}=10$, $C\_{4}=11$

Excitation table:

|  |  |  |  |
| --- | --- | --- | --- |
| $$y\_{1}$$ | $$y\_{0}$$ | $$y\_{1}^{+}$$ | $$y\_{0}^{+}$$ |
| 0 | 0 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 0 |

From table excitation vectors can be read directly:

$$y\_{1}^{+}=y\_{1}⨁y\_{0}$$

$$y\_{0}^{+}=\overbar{y\_{0}}$$



$$\overbar{y\_{0}}$$

$$y\_{0}$$

$$C\_{3}$$

$$C\_{2}$$

$$C\_{1}$$

$$C\_{0}$$

$$y\_{0}$$

$$y\_{1}$$

$$y\_{1}$$