Experiment No. 9
Implement Non-Restoring algorithm using c-programming
Name: Sharvari Anand Bhondekar
Roll Number: 06
Date of Performance:
Date of Submission:

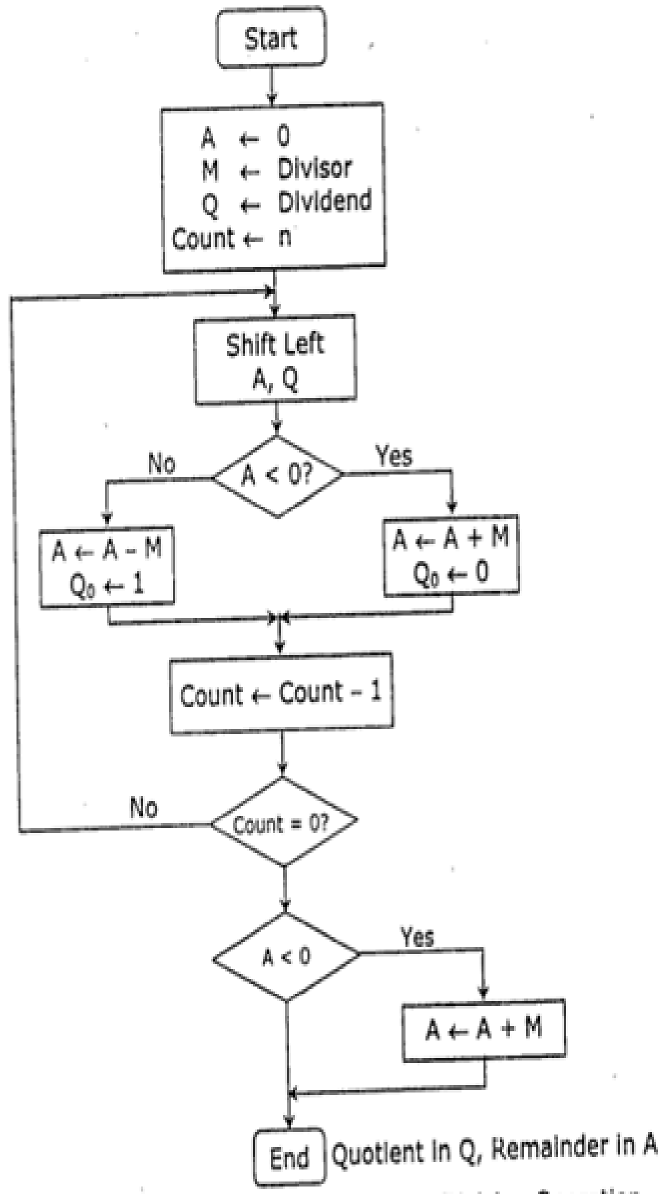
Aim - To implement Non-Restoring division algorithm using c-programming.

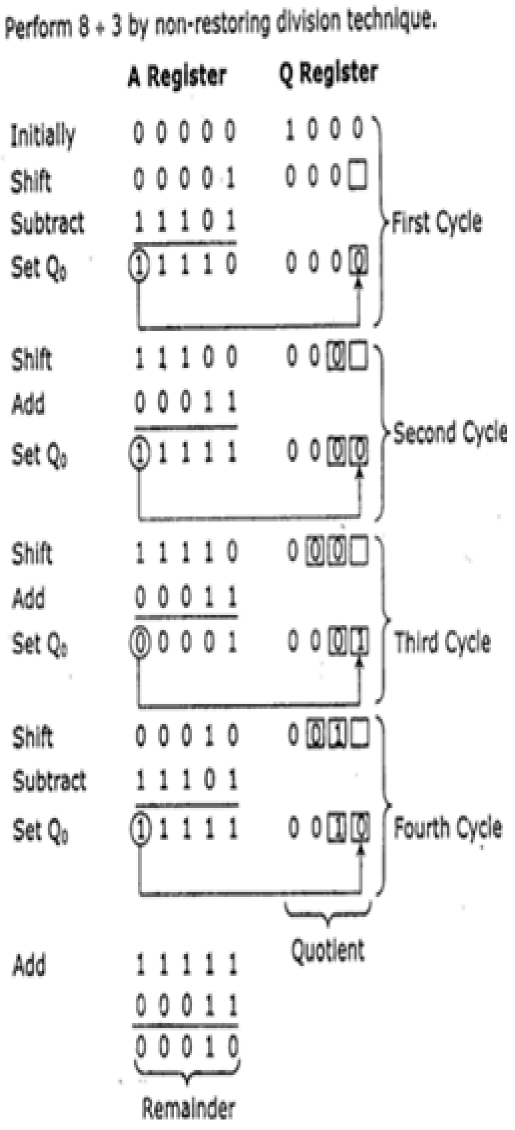
Objective -

1. To understand the working of Non-Restoring division algorithm.
2. To understand how to implement Non-Restoring division algorithm using c-programming.

Theory:

In each cycle content of the register, A is first shifted and then the divisor is added or subtracted with the content of register A depending upon the sign of A. In this, there is no need of restoring, but if the remainder is negative then there is a need of restoring the remainder. This is the faster algorithm of division.




Perform 8 ÷ 3 by non-restoring division technique.

	A Register	Q Register	
Initially	0 0 0 0 0	1 0 0 0	First Cycle
Shift	0 0 0 0 1	0 0 0 □	
Subtract	1 1 1 0 1		
Set Q_0	① 1 1 1 0	0 0 0 $\boxed{0}$	
Shift	1 1 1 0 0	0 0 $\boxed{0}$ □	Second Cycle
Add	0 0 0 1 1		
Set Q_0	① 1 1 1 1	0 0 $\boxed{0}$ $\boxed{0}$	
Shift	1 1 1 1 0	0 $\boxed{0}$ $\boxed{0}$ □	Third Cycle
Add	0 0 0 1 1		
Set Q_0	⓪ 0 0 0 1	0 0 $\boxed{0}$ $\boxed{1}$	
Shift	0 0 0 1 0	0 $\boxed{0}$ $\boxed{1}$ □	Fourth Cycle
Subtract	1 1 1 0 1		
Set Q_0	① 1 1 1 1	0 0 $\boxed{1}$ $\boxed{0}$	
		Quotient	
Add	1 1 1 1 1		
	0 0 0 1 1		
	0 0 0 1 0		
	Remainder		

Program -

```
#include <stdio.h>
#include <stdlib.h>
int dec_bin(int, int []);
int twos(int [], int []);
int left(int [], int []);
int add(int [], int []);
int main()
{
int a, b, m[4]={0,0,0,0}, q[4]={0,0,0,0}, acc[4]={0,0,0,0}, m2[4], i, n=4;
printf("Enter the Dividend: ");
scanf("%d", &a);
printf("Enter the Divisor: ");
scanf("%d", &b);
dec_bin(a, q);
dec_bin(b, m);
twos(m, m2);
printf("\nA\tQ\tComments\n");
for(i=3; i>=0; i--)
{
printf("%d", acc[i]);
}
printf("\t");
for(i=3; i>=0; i--)
{
printf("%d", q[i]);
}
printf("\tStart\n");
while(n>0)
{
left(acc, q);
for(i=3; i>=0; i--)
{
printf("%d", acc[i]);
}
printf("\t");
for(i=3; i>=1; i--)
{
printf("%d", q[i]);
}
```

```
printf("_\tLeft Shift A,Q\n");
add(acc, m2);
for(i=3; i>=0; i--)
{
printf("%d", acc[i]);
}
printf("\t");
for(i=3; i>=1; i--)
{
printf("%d", q[i]);
}
printf("_\tA=A-M\n");
if(acc[3]==0)
{
q[0]=1;
for(i=3; i>=0; i--)
{
printf("%d", acc[i]);
}
printf("\t");
for(i=3; i>=0; i--)
{
printf("%d", q[i]);
}
printf("\tQo=1\n");
}
else
{
q[0]=0;
add(acc, m);
for(i=3; i>=0; i--)
{
printf("%d", acc[i]);
}
printf("\t");
for(i=3; i>=0; i--)
{
printf("%d", q[i]);
}
printf("\tQo=0; A=A+M\n");
}
```

```
n--;
}
printf("\nQuotient = ");
for(i=3; i>=0; i--)
{
printf("%d", q[i]);
}
printf("\tRemainder = ");
for(i=3; i>=0; i--)
{
printf("%d", acc[i]);
}
printf("\n");
return 0;
}
int dec_bin(int d, int m[])
{
int b=0, i=0;
for(i=0; i<4; i++)
{
m[i]=d%2;
d=d/2;
}
return 0;
}
int twos(int m[], int m2[])
{
int i, m1[4];
for(i=0; i<4; i++)
{
if(m[i]==0)
{
m1[i]=1;
}
else
{
m1[i]=0;
}
}
for(i=0; i<4; i++)
{
```

```
m2[i]=m1[i];
}
if(m2[0]==0)
{
m2[0]=1;
}
else
{
m2[0]=0;
if(m2[1]==0)
{
m2[1]=1;
}
else
{
m2[1]=0;
if(m2[2]==0)
{
m2[2]=1;
}
else
{
m2[2]=0;
if(m2[3]==0)
{
m2[3]=1;
}
else
{
m2[3]=0;
}
}
}
}
return 0;
}
int left(int acc[], int q[])
{
int i;
for(i=3; i>0; i--)
{
```

```
acc[i]=acc[i-1];
}
acc[0]=q[3];
for(i=3; i>0; i--)
{
q[i]=q[i-1];
}
}
int add(int acc[], int m[])
{
int i, carry=0;
for(i=0; i<4; i++)
{
if(acc[i]+m[i]+carry==0)
{
acc[i]=0;
carry=0;
}
else if(acc[i]+m[i]+carry==1)
{
acc[i]=1;
carry=0;
}
else if(acc[i]+m[i]+carry==2)
{
acc[i]=0;
carry=1;
}
else if(acc[i]+m[i]+carry==3)
{
acc[i]=1;
carry=1;
}
}
return 0;
}
```

Output:

```
Enter the Dividend: 216
Enter the Divisor: 6
```

A	Q	Comments
0000	1000	Start
0001	000_	Left Shift A,Q
1011	000_	A=A-M
0001	0000	Qo=0; A=A+M
0010	000_	Left Shift A,Q
1100	000_	A=A-M
0010	0000	Qo=0; A=A+M
0100	000_	Left Shift A,Q
1110	000_	A=A-M
0100	0000	Qo=0; A=A+M
1000	000_	Left Shift A,Q
0010	000_	A=A-M
0010	0001	Qo=1

Quotient = 0001 Remainder = 0010

Conclusion -

This experiment successfully demonstrated the implementation of the Non-Restoring Division Algorithm using C programming. The algorithm efficiently divided two binary numbers by repeatedly subtracting the divisor and adjusting the quotient without needing to restore the remainder after unsuccessful subtractions. Instead of adding the divisor back (as in the restoring division), the algorithm continued with the shifted partial remainder. The quotient and remainder were correctly stored in the Q and A registers, respectively, by the end of the process. This implementation provided a clear understanding of how non-restoring division simplifies the division process, making it more efficient for certain hardware applications.