Experiment No. 8
Implement Restoring algorithm using c-programming
Name: Gautam D. Chaudhari
Roll Number: 04
Date of Performance:
Date of Submission:

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

Objective -

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

Theory:

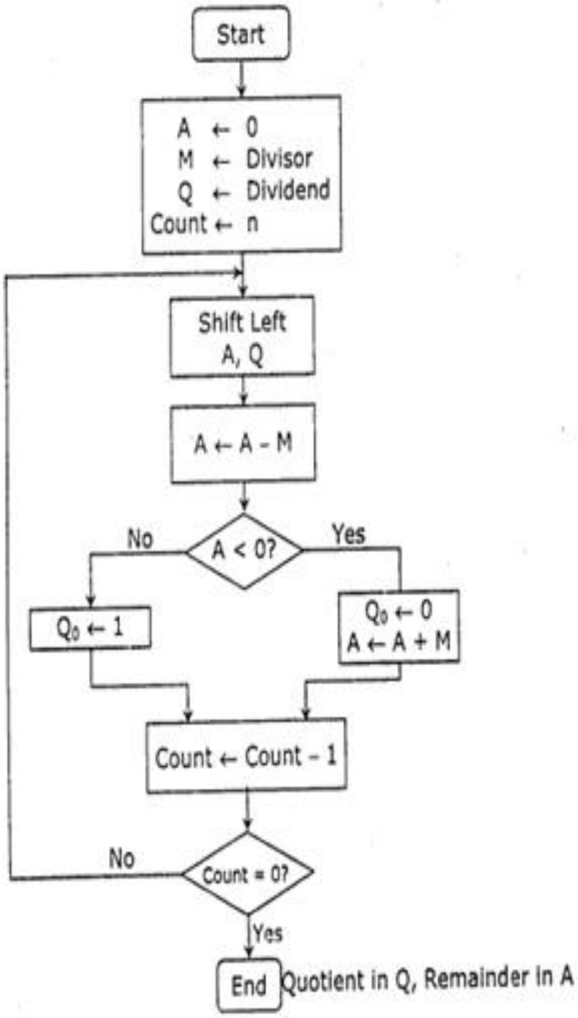
1) The divisor is placed in M register, the dividend placed in Q register.

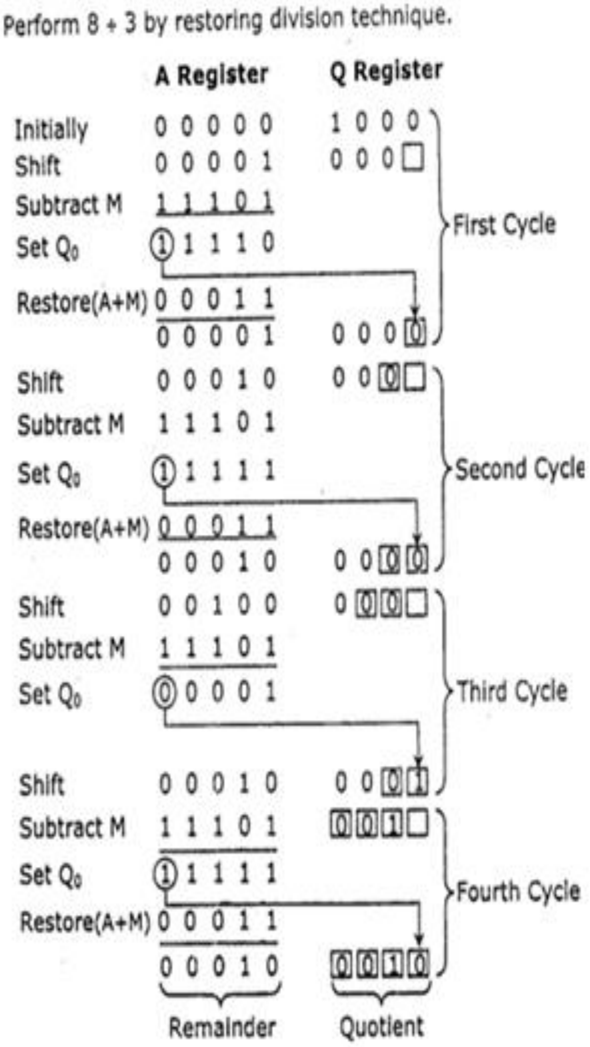
2) At every step, the A and Q registers together are shifted to the left by 1-bit

3) M is subtracted from A to determine whether A divides the partial remainder. If it does, then Q0 set to 1-bit. Otherwise, Q0 gets a 0 bit and M must be added back to A to restore the previous value.

4) The count is then decremented and the process continues for n steps. At the end, the quotient is in the Q register and the remainder is in the A register.

Flowchart




Perform 8 ÷ 3 by 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 M	1 1 1 0 1		
Set Q_0	1 1 1 1 0		
Restore(A+M)	0 0 0 1 1		
	0 0 0 0 1	0 0 0 0	
Shift	0 0 0 1 0	0 0 0 □	Second Cycle
Subtract M	1 1 1 0 1		
Set Q_0	1 1 1 1 1		
Restore(A+M)	0 0 0 1 1		
	0 0 0 1 0	0 0 0 0	
Shift	0 0 1 0 0	0 0 0 □	Third Cycle
Subtract M	1 1 1 0 1		
Set Q_0	0 0 0 0 1		
Shift	0 0 0 1 0	0 0 0 1	
Subtract M	1 1 1 0 1	0 0 1 □	Fourth Cycle
Set Q_0	1 1 1 1 1		
Restore(A+M)	0 0 0 1 1		
	0 0 0 1 0	0 0 1 0	
	Remainder	Quotient	

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;
```

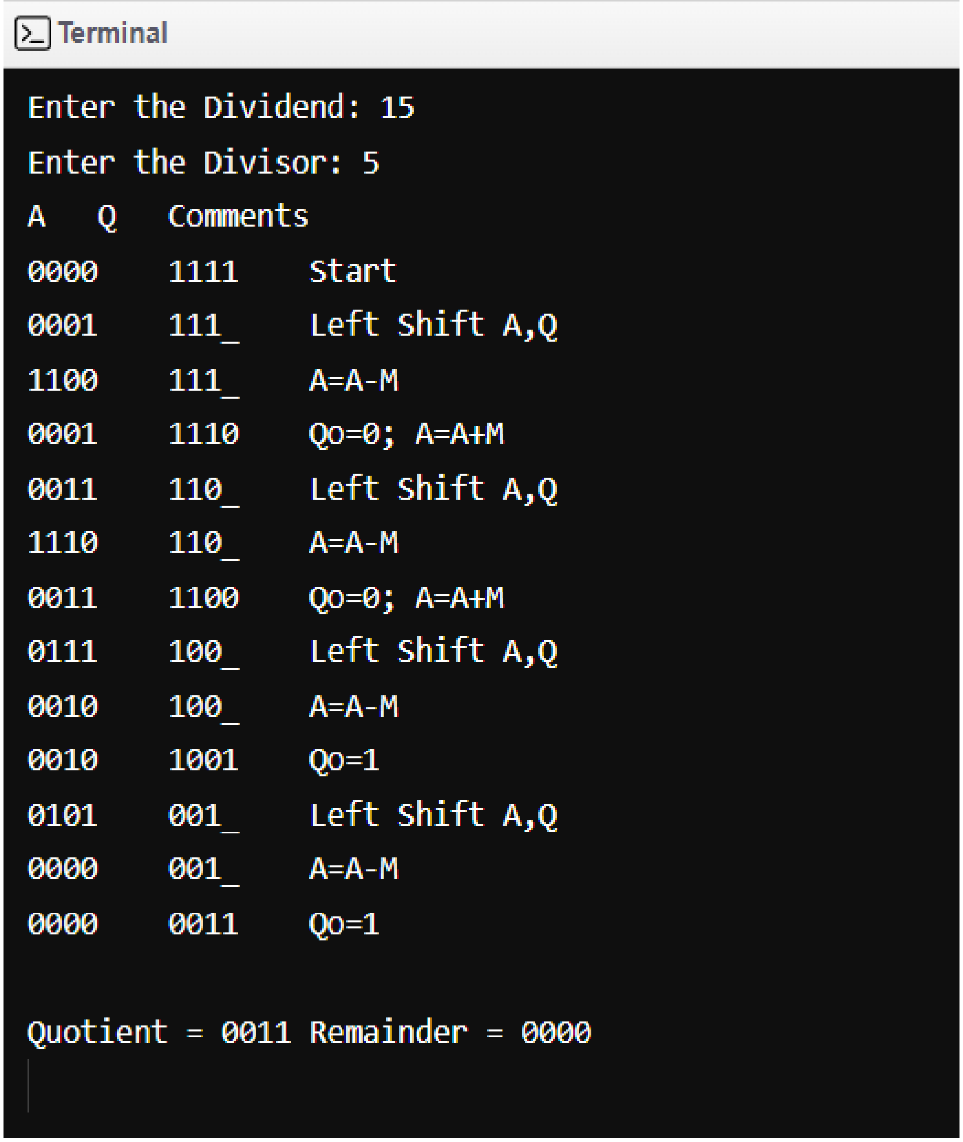
```
                }
            }
        }
    }
    return 0;
}

+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: 15
Enter the Divisor: 5
A   Q   Comments
0000    1111    Start
0001    111_    Left Shift A,Q
1100    111_    A=A-M
0001    1110    Qo=0; A=A+M
0011    110_    Left Shift A,Q
1110    110_    A=A-M
0011    1100    Qo=0; A=A+M
0111    100_    Left Shift A,Q
0010    100_    A=A-M
0010    1001    Qo=1
0101    001_    Left Shift A,Q
0000    001_    A=A-M
0000    0011    Qo=1

Quotient = 0011 Remainder = 0000
```

Conclusion -

The experiment with the Restoring Division Algorithm helped us understand how to divide binary numbers step by step. This method is essential for accurate division in computer math. This hands-on experience reinforced the importance of knowing and using division algorithms, showing us how they are applied in various computer systems and data processing tasks.