Experiment No. 8
Implement Restoring algorithm using c-programming
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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:

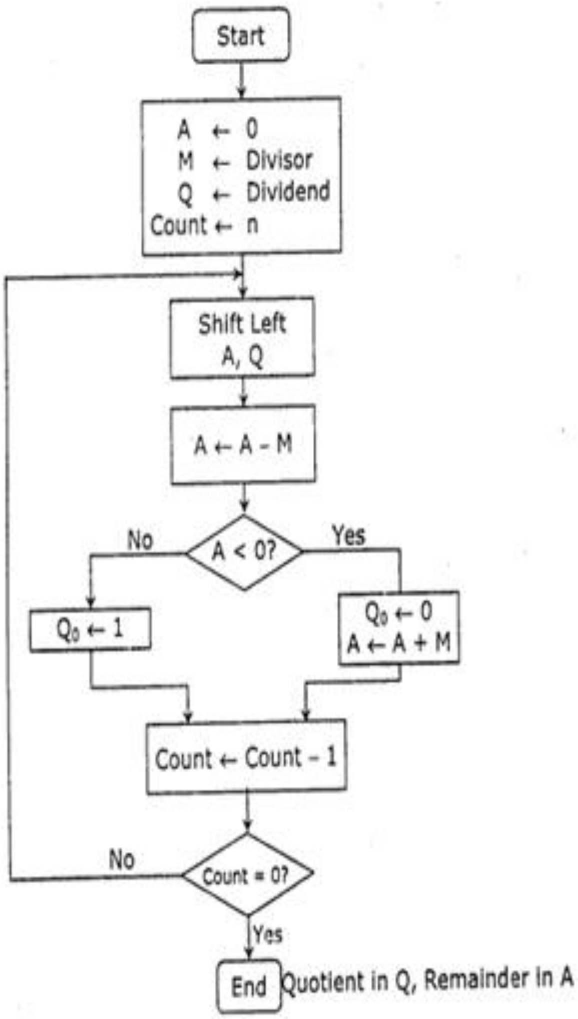
1) The divisor is placed in M register, the dividend placed in Q register.

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

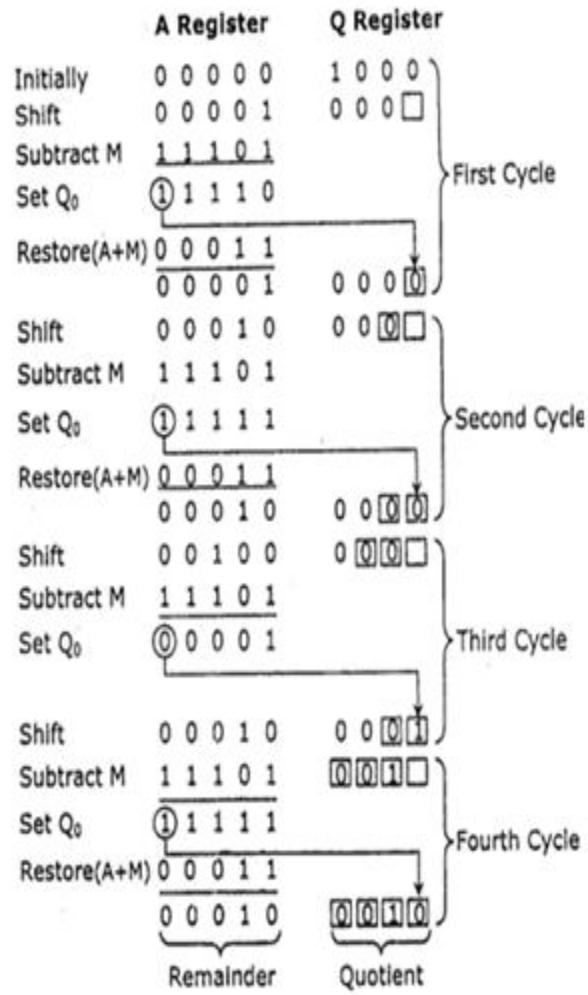
3) M is subtracted from A to determine whether A divides the partial remainder. If it does, then Q0 set to 1-bit. Otherwise, Q0 gets a 0 bit and M must be added back to A to restore the previous value.

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.



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: 12
Enter the Divisor: 2

A	Q	Comments
0000	1100	Start
0001	100_	Left Shift A,Q
1111	100_	A=A-M
0001	1000	Qo=0; A=A+M
0011	000_	Left Shift A,Q
0001	000_	A=A-M
0001	0001	Qo=1
0010	001_	Left Shift A,Q
0000	001_	A=A-M
0000	0011	Qo=1
0000	011_	Left Shift A,Q
1110	011_	A=A-M
0000	0110	Qo=0; A=A+M

Quotient = 0110   Remainder = 0000

Conclusion -

Our thorough exploration of the Restoring Division Algorithm in this experiment has bestowed upon us a holistic comprehension of this foundational technique for binary division. The algorithm's meticulous step-by-step restoration approach stands as a cornerstone for achieving precise quotient calculation, rendering it an invaluable asset in the realm of computer arithmetic.

Our experiment extended beyond just grasping the theory; it emphasized the practical significance of comprehending and implementing division algorithms. As we immersed ourselves in the intricacies of this algorithm, we could clearly discern its real-world applicability in diverse computer systems and data processing tasks. This hands-on experience reinforced the critical role division algorithms play in modern computing, serving as a reminder of their practical importance in various computational processes and systems.