Experiment 9

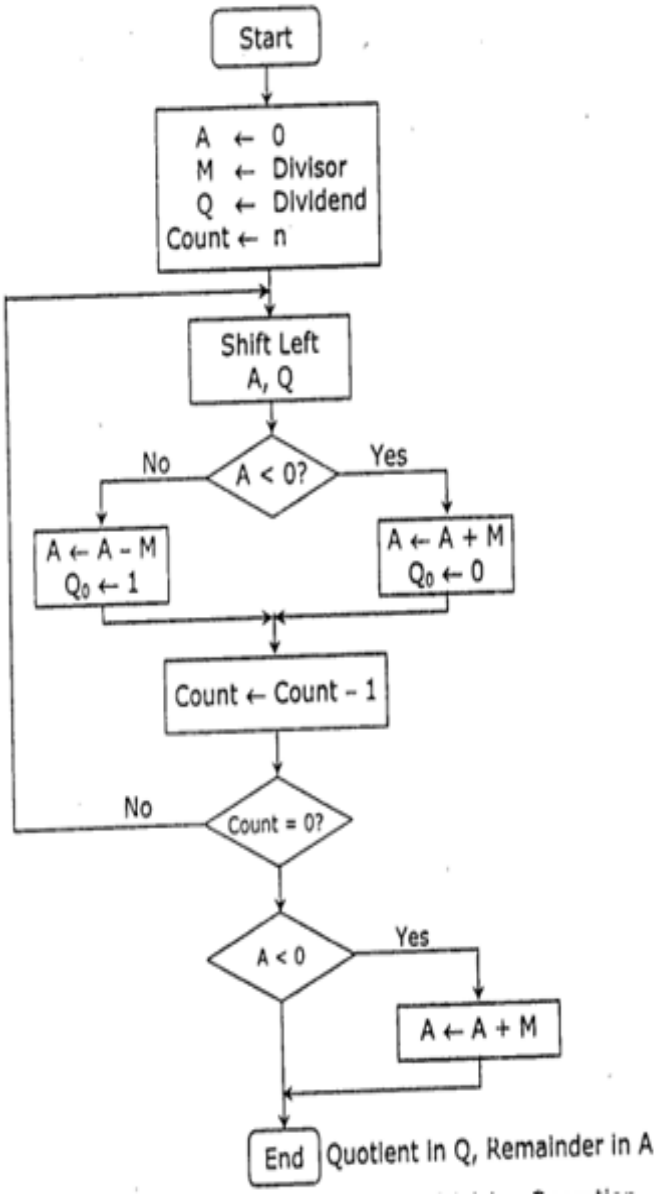
Aim - To implement Non-Restoring division algorithm using c-programming.

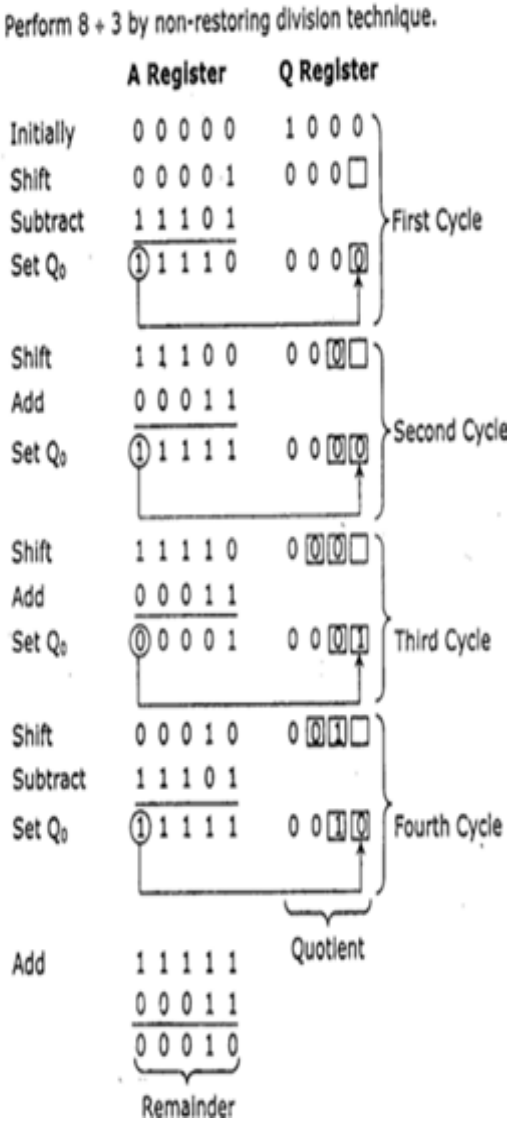
Objective -

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.





Program –

```
#include <math.h>
#include <stdio.h>
//NON RESTORING DIVISION
int main()
{
int a[50],a1[50],b[50],d=0,i,j;
 int n1,n2, c, k1,k2,n,k,quo=0,rem=0;
   printf("Enter the number of bits\n");
   scanf("%d",&n);
 printf("Enter the divisor and dividend\n");
 scanf("%d %d", &n1,&n2);

 for (c = n-1; c >= 0; c--)//converting the 2 nos to binary
 {
   k1 = n1 >> c;

   if (k1 & 1)
     a[n-1-c]=1;// M
   else
    a[n-1-c]=0;

    k2 = n2 >> c;

   if (k2 & 1)
     b[2*n-1-c]=1;// Q
   else
    b[2*n-1-c]=0;

 }

 for(i=0;i<n;i++)//making complement
 {
    if(a[i]==0)
      a1[i]=1;
    else
```

```
      a1[i]=0;
  }

  a1[n-1]+=1;//twos complement ie -M

  if(a1[n-1]==2)
  {
        for(i=n-1;i>0;i--)
     {
          if(a1[i]==2)
        {
           a1[i-1]+=1;
           a1[i]=0;
        }
     }
  }
  if(a1[0]==2)
    a1[0]=0;

  for( i=0;i<n;i++)// putting A in the same array as Q
  {
     b[i]=0;

  }

printf("A\tQ\tPROCESS\n");

  for(i=0;i<2*n;i++)
{
    if(i==n)
       printf("\t");

    printf("%d",b[i]);
}
 printf("\n");

  for(k=0;k<n;k++)//n iterations
  {
     for(j=0;j<2*n-1;j++)//left shift
       {
         b[j]=b[j+1];

       }

       for(i=0;i<2*n -1;i++)
       {
          if(i==n)
             printf("\t");
          printf("%d",b[i]);
       }printf("_");
```

```
printf("\tLEFT SHIFT\n");

   if(b[0]==0)
   {
            for(i=n-1;i>=0;i--)//A=A-M
            {
               b[i]+=a1[i];

                  if(i!=0)
              {
                  if(b[i]==2)
                        {
                           b[i-1]+=1;
                           b[i]=0;
                        }
                  if(b[i]==3)
                        {
                           b[i-1]+=1;
                           b[i]=1;
                        }
                       // printf("%d",b[i]);
               }
            }
                  if(b[0]==2)
                     b[0]=0;

                  if(b[0]==3)
                     b[0]=1;

            for(i=0;i<2*n -1;i++)
            {
               if(i==n)
                  printf("\t");



               printf("%d",b[i]);
            }printf("_");

            printf("\tA-M\n");
   }

   else
   {
            for(j=n-1;j>=0;j--)//A=A+M
               {
                  b[j]+=a[j];

                  if(j!=0)
              {
                  if(b[j]==2)
```

```
                {
                   b[j-1]+=1;
                   b[j]=0;
                }
            if(b[j]==3)
                {
                   b[j-1]+=1;
                   b[j]=1;
                }
          }

            if(b[0]==2)
               b[0]=0;

            if(b[0]==3)
               b[0]=1;
          }

          for(i=0;i<2*n -1;i++)
        {
          if(i==n)
             printf("\t");



          printf("%d",b[i]);
        }printf("_");

        printf("\tA+M\n");

}



   if(b[0]==0)//A==0?
   {
      b[2*n-1]=1;
      for(i=0;i<2*n ;i++)
        {
          if(i==n)
             printf("\t");



          printf("%d",b[i]);
        }

        printf("\tQ0=1\n");
   }
```

```
            if(b[0]==1)//A==1?
            {
               b[2*n-1]=0;
               for(i=0;i<2*n ;i++)
                 {
                    if(i==n)
                       printf("\t");



                    printf("%d",b[i]);
                 }

                 printf("\tQ0=0\n");

            }

 }

if(b[0]==1)
{
              for(j=n-1;j>=0;j--)//A=A+M
                   {
                      b[j]+=a[j];

                      if(j!=0)
                     {
                      if(b[j]==2)
                            {
                               b[j-1]+=1;
                               b[j]=0;
                            }
                      if(b[j]==3)
                            {
                               b[j-1]+=1;
                               b[j]=1;
                            }
                   }

                      if(b[0]==2)
                         b[0]=0;

                      if(b[0]==3)
                         b[0]=1;
                   }

                      for(i=0;i<2*n;i++)
                   {
                      if(i==n)
                         printf("\t");
```

```
                printf("%d",b[i]);
            }

            printf("\tA+M\n");
}
 printf("\n");
for(i=n;i<2*n;i++)
{
   quo+= b[i]*pow(2,2*n-1-i);
}
for(i=0;i<n;i++)
{
   rem+= b[i]*pow(2,n-1-i);
}
printf("The quotient of the two nos is %d\nThe remainder is %d",quo,rem);

 printf("\n");
  return 0;
}
```

Output:

Conclusion –

In this work, I am trying to improve the non-restoring algorithm to minimize the hardware cost. If dividend & divisor both are negative then proposed algorithm will not work. Though, in future I can develop this algorithm to divide two signed binary numbers.