Experiment No. 8
Implement Restoring algorithm using c-programming
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Aim: To implement Restoring division algorithm using c-programming.

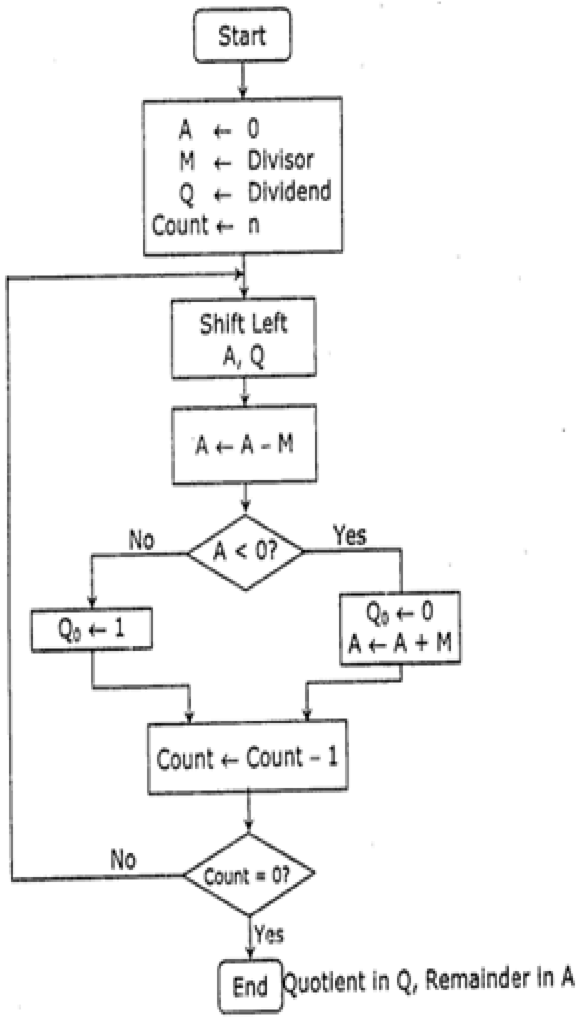
Objective -

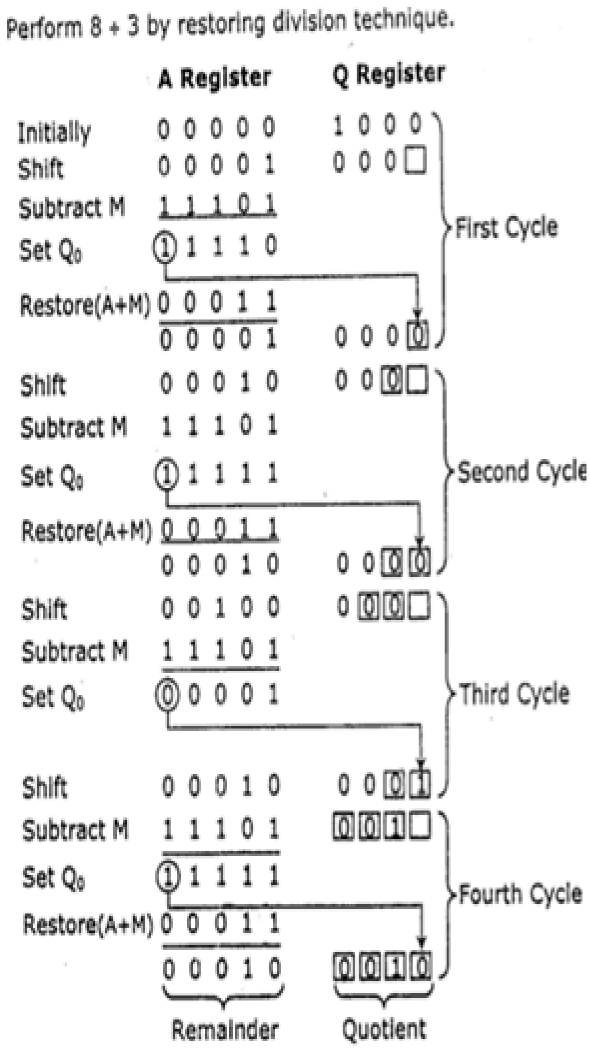
1. To understand the working of Restoring division algorithm.
2. To understand how to implement Restoring division algorithm using c-programming.

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





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 -

```
Q:  10, A:   0, M:   5 [00000000 00001010]
Q:  20, A:   0, M:   5 [00000000 00010100]
Q:  40, A:   0, M:   5 [00000000 00101000]
Q:  80, A:   0, M:   5 [00000000 01010000]
Q: 160, A:   0, M:   5 [00000000 10100000]
Q:  64, A:   1, M:   5 [00000001 01000000]
Q: 128, A:   2, M:   5 [00000010 10000000]
Q:   1, A:   0, M:   5 [00000000 00000001]
Q:   2, A:   0, M:   5 [00000000 00000010]
10 / 5 = 2
10 % 5 = 0
```

Conclusion -

This experiment successfully demonstrated the implementation of the Restoring Division Algorithm in C programming. The algorithm divides two binary numbers by repeatedly subtracting the divisor from the partial remainder and updating the quotient. It uses shift operations and restores the remainder when necessary, ensuring accurate division. The quotient and remainder were correctly stored in the Q and A registers, respectively. This experiment deepened the understanding of the Restoring Division Algorithm, emphasizing its significance in binary division and its efficient handling of signed numbers in digital systems.