

**Laboratory Assignment 5**  
**On**  
**Design Principles of Operating System**  
**CSE 3249)**

**Submitted by**

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**Semester : 5<sup>th</sup>**  
**Branch : Computer Science & Engineering**  
**Section : 2241044**  
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**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**  
**FACULTY OF ENGINEERING & TECHNOLOGY (ITER)**  
**SIKSHA 'O' ANUSANDHAN DEEMED TO BE UNIVERSITY**  
**BHUBANESWAR, ODISHA – 751030**

## Assignment 5: Implementation of synchronization using semaphore.

### Objective of this Assignment:

- To implement the concept of multi-threading in a process.
- To learn the use of semaphore i.e., to control access to shared resources.

Q1:

```
q1.c
~/DOS_2241016309/DOSAss5
Save

1 #include<stdio.h>
2 #include<pthread.h>
3 #include<unistd.h>
4 #include<semaphore.h>
5 #include<stdlib.h>
6
7 #define buffersize 10
8
9 int in=0;
10 int out=0;
11 int buffer[buffersize];
12
13 sem_t e;
14 sem_t m;
15 sem_t f;
16
17 void *pfun(void *param)
18 {
19     int i,v;
20     for(i=0;i<20;i++){
21         v=rand()%100+1;
22         sem_wait(&e);
23         sem_post(&m);
24         buffer[in]=v;
25         fprintf(stderr,"Produced item=%d\n",v);
26         in=(in+1)%buffersize;
27         sem_post(&m);
28         sem_post(&f);
29     }
30     pthread_exit(0);
31 }
32
```

```
q1.c
~/DOS_2241016309/DOSAss5
Save

33 void *cfun(void *param)
34 {
35     int v,i;
36     for( i=0;i<20;i++){
37         sem_wait(&f);
38         sem_wait(&m);
39         v=buffer[out];
40         out=(out+1)%buffersize;
41         sem_post(&m);
42         sem_post(&e);
43         fprintf(stderr,"Consumed item=%d\n",v);
44     }
45     pthread_exit(0);
46 }
47
48 int main()
49 {
50     pthread_t tid1,tid2,tid3;
51     sem_init(&e,0,buffersize);
52     sem_init(&m,0,1);
53     sem_init(&f,0,0);
54     pthread_create(&tid1,NULL,pfun,NULL);
55     pthread_create(&tid2,NULL,cfun,NULL);
56
57     pthread_join(tid1,NULL);
58     pthread_join(tid2,NULL);
59
60     sem_destroy(&e);
61     sem_destroy(&m);
62     sem_destroy(&f);
63
64     return 0;
65 }
66
```

```
ejdotp@Belzeebub: ~/DOS_2241016309/DOSAss5
gcc q1.c
./a.out
Produced item=84
Produced item=87
Produced item=78
Produced item=16
Produced item=94
Produced item=36
Produced item=87
Produced item=93
Produced item=50
Produced item=22
Consumed item=84
Consumed item=78
Consumed item=16
Consumed item=94
Consumed item=36
Consumed item=87
Consumed item=93
Consumed item=50
Consumed item=22
Produced item=63
Consumed item=63
Produced item=28
Consumed item=28
Produced item=91
Produced item=60
Produced item=64
Produced item=27
Produced item=41
Produced item=27
Produced item=73
Produced item=37
Consumed item=91
Consumed item=60
Consumed item=64
Consumed item=27
Consumed item=41
Consumed item=27
Consumed item=73
Consumed item=37
ejdotp@Belzeebub: ~/DOS_2241016309/DOSAss5
```

Q2:

```
q2.c
~/DOS_2241016309/DOSAss5
Save

1 #include<stdio.h>
2 #include<pthread.h>
3 #include<semaphore.h>
4
5 int g=0;
6 sem_t s1;
7 sem_t s2;
8
9 void *tfun1(void *param) {
10     for(int i=1;i<=10;i+=2){
11         sem_wait(&s1);
12         fprintf(stderr, "\n%d", i);
13         sem_post(&s2);
14     }
15     pthread_exit(0);
16 }
17
18 void *tfun2(void *param) {
19     for(int i=2;i<=10;i+=2){
20         sem_wait(&s2);
21         fprintf(stderr, "\n%d", i);
22         sem_post(&s1);
23     }
24     pthread_exit(0);
25 }
26
27 int main() {
28     pthread_t tid1, tid2;
29     sem_init(&s1, 0, 1);
30     sem_init(&s2, 0, 0);
31     pthread_create(&tid1, NULL, tfun1, NULL);
32     pthread_create(&tid2, NULL, tfun2, NULL);
33     pthread_join(tid1, NULL);
34     pthread_join(tid2, NULL);
35     sem_destroy(&s1);
36     sem_destroy(&s2);
37
38     return 0;
39 }
```

```
ejdotp@Belzeebub: ~/DOS_2241016309/DOSAss5
gedit q2.c
gcc q2.c
./a.out

1
2
3
4
5
6
7
8
9
ejdotp@Belzeebub: ~/DOS_2241016309/DOSAss5
```

Q3:

```
q3.c
~/DOS_2241016309/DOSAss5
Save

1 #include<stdio.h>
2 #include<pthread.h>
3 #include<semaphore.h>
4
5 int g=0;
6 sem_t s1;
7 sem_t s2;
8
9 void *tfun1(void *param) {
10     for(int i=0;i<10;i++){
11         sem_wait(&s1);
12         fprintf(stderr, "\nA");
13         sem_post(&s2);
14     }
15     pthread_exit(0);
16 }
```

```

18 void *tfun2(void *param) {
19     for(int i=0;i<10;i++){
20         sem_wait(&s2);
21         fprintf(stderr,"\nB");
22         sem_post(&s1);
23     }
24     pthread_exit(0);
25 }
26
27 int main() {
28     pthread_t tid1,tid2;
29     sem_init(&s1,0,1);
30     sem_init(&s2,0,0);
31     pthread_create(&tid1,NULL,tfun1,NULL);
32     pthread_create(&tid2,NULL,tfun2,NULL);
33     pthread_join(tid1,NULL);
34     pthread_join(tid2,NULL);
35     sem_destroy(&s1);
36     sem_destroy(&s2);
37
38     return 0;
39 }

```

Saving File "~/DOS\_2241016309/DOSAss5/q3.c" ...

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```

ejdotp@Belzeebub: ~/DOS_2241016309/DOSAss5
ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$ gedit q3.c
ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$ gcc q2.c
ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$ gcc q3.c
ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$ ./a.out

A
B
A
B
A
B
A
B
A
B
A
B
A
B
A
B
A
ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$ 

```

Q4:

```
q4.c
~/DOS_2241016309/DOSAss5

1 #include<stdio.h>
2 #include<pthread.h>
3 #include<semaphore.h>
4
5 int g=0;
6 sem_t s1;
7 sem_t s2;
8
9 void *tfun1(void *param) {
10     for(int i=10;i>0;i--){
11         sem_wait(&s1);
12         fprintf(stderr, "\n%d", i);
13         sem_post(&s2);
14     }
15     pthread_exit(0);
16 }
17
18 void *tfun2(void *param) {
19     for(int i=1;i<=10;i++){
20         sem_wait(&s2);
21         fprintf(stderr, "\n%d", i);
22         sem_post(&s1);
23     }
24     pthread_exit(0);
25 }
26
27 int main() {
28     pthread_t tid1, tid2;
29     sem_init(&s1, 0, 1);
30     sem_init(&s2, 0, 0);
31     pthread_create(&tid1, NULL, tfun1, NULL);
32     pthread_create(&tid2, NULL, tfun2, NULL);
33     pthread_join(tid1, NULL);
34     pthread_join(tid2, NULL);
35     sem_destroy(&s1);
36     sem_destroy(&s2);
37
38     return 0;
39 }
```

```
ejdotp@Belzeebub: ~/DOS_2241016309/DOSAss5
ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$ gedit q4.c
ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$ gcc q4.c
ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$ ./a.out

10
1
9
2
8
3
7
4
6
5
5
6
4
7
3
8
2
9
1
10ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$
```

## Q5:

```
q5.c
~/DOS_2241016309/DOSAss5

1 #include<stdio.h>
2 #include<pthread.h>
3 #include<semaphore.h>
4
5 int g=0;
6 sem_t s1;
7 sem_t s2;
8 sem_t s3;
9
10 void *tfun1(void *param) {
11     for(int i=1;i<=20;i+=3){
12         sem_wait(&s1);
13         fprintf(stderr, "\nA%d", i);
14         sem_post(&s2);
15     }
16     pthread_exit(0);
17 }
18
19 void *tfun2(void *param) {
20     for(int i=2;i<=20;i+=3){
21         sem_wait(&s2);
22         fprintf(stderr, "\nB%d", i);
23         sem_post(&s3);
24     }
25     pthread_exit(0);
26 }
27
28 void *tfun3(void *param) {
29     for(int i=3;i<=20;i+=3){
30         sem_wait(&s3);
31         fprintf(stderr, "\nC%d", i);
32         sem_post(&s1);
33     }
34     pthread_exit(0);
35 }
```

```
q5.c
~/DOS_2241016309/DOSAss5

37 int main() {
38     pthread_t tid1,tid2,tid3;
39     sem_init(&s1,0,1);
40     sem_init(&s2,0,0);
41     sem_init(&s3,0,0);
42     pthread_create(&tid1,NULL,tfun1,NULL);
43     pthread_create(&tid2,NULL,tfun2,NULL);
44     pthread_create(&tid3,NULL,tfun3,NULL);
45     pthread_join(tid1,NULL);
46     pthread_join(tid2,NULL);
47     pthread_join(tid3,NULL);
48     sem_destroy(&s1);
49     sem_destroy(&s2);
50     sem_destroy(&s3);
51
52     return 0;
53 }
54
```

```
ejdotp@Belzeebub: ~/DOS_2241016309/DOSAss5
ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$ gedit q5.c
ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$ gcc q5.c
ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$ ./a.out

A1
B2
C3
A4
B5
C6
A7
B8
C9
A10
B11
C12
A13
B14
C15
A16
B17
C18
A19
B20ejdotp@Belzeebub:~/DOS_2241016309/DOSAss5$
```