United International University
Spring 2025, Operating System Concepts
Class Test - 4 (Set A), Time: 30 minutes, Marks: 20

1. Look at the code snippet below and answer the questions.

```
1   #include <bits/stdc++.h>
2   using namespace std;
3   #define NUM_OF_PERSON 5
4   #define THINK 5
5   bool forks[NUM_OF_PERSON]={1,1,1,1,1};
6
7   void acquire(bool *available){
8       while(*available==false);
9       *available = false;
10  }
11  void release(bool *available){
12      *available = true;
13  }
14  void philosopher_meetup(int i){
15      if(i%2){
16          acquire(&forks[i]);
17          sleep(THINK);
18          acquire(&forks[(i+1)%NUM_OF_PERSON]);
19          release(&forks[i]);
20          release(&forks[(i+1)%NUM_OF_PERSON]);
21          printf("When Synchronization meets Deadlock!\n");
22      }
23      else{
24          acquire(&forks[(i+1)%NUM_OF_PERSON]);
25          sleep(THINK);
26          acquire(&forks[i]);
27          release(&forks[i]);
28          release(&forks[(i+1)%NUM_OF_PERSON]);
29          printf("Are philosophers in deadlock?\n");
30      }
31  }
32  int main()
33  {
34      thread threads[NUM_OF_PERSON];
35      for (int i = 0; i < NUM_OF_PERSON; ++i) {
36          threads[i] = thread(philosopher_meetup,i);
37      }
38      for (int i = 0; i < NUM_OF_PERSON; ++i) {
39          threads[i].join();
40      }
41
42      return 0;
43  }
```

a) Draw the resource allocation graph for the above code. [4 marks]
b) Is there a deadlock? If so, identify the philosopher IDs responsible for the deadlock. Otherwise, determine the output. [2 marks]
c) What will happen if we replace the statement of lines 25 and 27? [4 marks]

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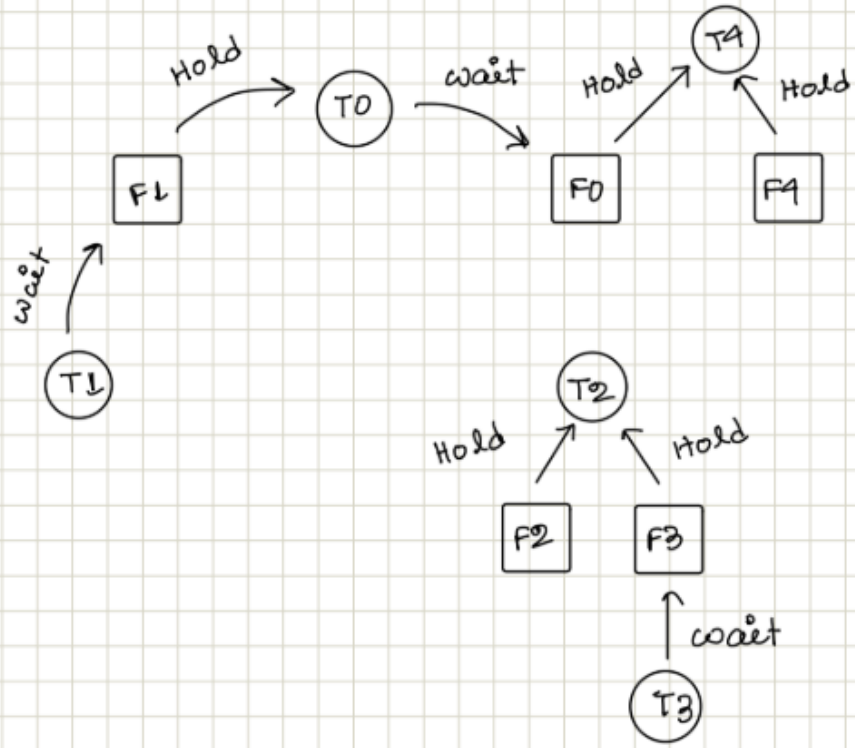
Solution to 1:

	Thread	Hold	Wait
~~sleep~~ (waiting F0)	T0 (else)	F1	F0
waiting F1	T1 (if)		F1
~~sleep~~	T2 (else)	F3, F2	
waiting F3	T3 (if)		F3
~~sleep~~	T4 (else)	F0, F4	



∴ There is no deadlock

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Output:

```
When Synchronization meets Deadlock!
Are philosophers in deadlock?
Are philosophers in deadlock?
When Synchronization meets Deadlock!
When Synchronization meets Deadlock!
```

1(c): Hold and wait will be prevented if we interchange those two lines.

2. Consider the Table-1 snapshot of a system:

Process	Allocation				Max			
	A	B	C	D	A	B	C	D
T0	3	0	1	4	5	1	1	7
T1	2	2	1	0	3	2	1	1
T2	3	1	2	1	3	3	2	1
T3	0	5	1	0	4	6	1	2
T4	4	2	1	2	6	3	2	5

Table 1: Process along with resources

a) Determine whether the system is in a safe state or not if the available resources are {0,3,0,1}? If the state is safe, illustrate the order in which the threads may be completed. Otherwise,Calculate the minimum number of additional available resources required to ensure the execution of all threads. [5+2 marks]

b) "If a request from thread T3 arrives for (0,0,0,1), the request will be granted immediately."- Justify the statement. [Assume, available resources={1,0,0,2}] [3 marks]

Solution: Same as set B question