1. Give the migration diagram of process with 5 states,and indicate the migration reasons. (10 points)

2. What is the deadlock? How to prevent the deadlock occurred ? How to avoid the deadlock occurred ? What are the reasons that cause the deadlock? What are the necessary conditions when the deadlock occur? (10 points)

参考答案：

Answer(1):A set of blocked processes each holding a resource and waiting to acquire a resource held by another process in the set.

How to prevent the deadlock occurred ?

Answer(2):By ensuring that at least one of four conditions(Mutual Exclusion, Hold and Wait ,No Preemption , Circular Wait) cannot hold, we can prevent the occurrence of a deadlock.

Answer(3):

To use Safety Algorithm:

If a system is in safe state ⇒ no deadlocks.

If a system is in unsafe state ⇒ possibility of deadlock.

Avoidance ⇒ ensure that a system will never enter an unsafe state.

Answer(4):

1) 系统资源不足，分配不当
2) 进程推进顺序不合理

Answer(5):

产生死锁的 4 个必要条件：

（1）互斥条件：一个资源每次只能被一个进程使用。

（2）请求与保持条件：一个进程因请求资源而阻塞时，对已获得的资源保持不放。

（3）不剥夺条件:进程已获得的资源，在未使用完之前，不能强行剥夺。

（4）循环等待条件:若干进程之间形成一种头尾相接的循环等待资源关系。

参考例题：

Suppose there are three types of resources (A, B, C) and five processes (P1, P2, and P3, and P4, and P5). A: the number of resources is 17, B: the number of resources is 5, the amount of resources is 20 for C. System state in time T0 as shown in Table 1 and Table 2 below, the system uses the bankers algorithm implementation deadlock avoidance strategy.(10 points)

(1) Time T0 is a safe state? If yes, please give the security sequence.
(2) Time T0 process P2 request resource (0,3,4), whether the implementation of the allocation of resources? Why?
(3) On the basis of (2), if the process P4 requested resource (2,0,1), whether or not able to implement resource allocation? Why?
(4) On the basis of (3), if a process requests a resource (0,2,0), whether the implementation of the allocation of resources? Why?

Table 1: The T0 time system state

Process	Maximum demand for resources			The number of resources allocated		
	A	B	C	A	B	C
P1	5	5	9	2	1	2
P2	5	3	6	4	0	2
P3	4	0	11	4	0	5
P4	4	2	5	2	0	4
P5	4	2	4	3	1	4

Table 2: The T0 time system state

	A	B	C
The number of remaining resources	2	3	3

参考答案;

a) T0 时刻是安全状态，安全序列为：如 p5,p4,p3,p2,p1
b) 不可以，由银行家算法可得到，不满足 request<=available,进程 p2 请求的超过了系统剩余的资源量
c) 可以，根据银行家算法，存在一个安全序列。（画图说明给满分）
d) 不可以，根据银行家算法，找不到一个安全序列。（要具体说明，画图给满分）

5. Programming(15 points)

The Cigarette-Smokers Problem. Consider a system with three smoker processes and one agent process. Each smoker continuously rolls a cigarette and then smokes it. But to roll and smoke a cigarette, the smoker needs three ingredients: tobacco, paper, and matches. One of the smoker processes has paper, another has tobacco, and the third has matches. The agent has an infinite supply of all three materials. The agent places two of the ingredients on the table. The smoker who has the remaining ingredient then makes and smokes a cigarette, signaling the agent on completion. The agent then puts out another two of the three ingredients, and the cycle repeats. Write a program to synchronize the agent and the smokers using Java synchronization（or vc++ with P and V operations）

参考例题：

If there is 4 processes, they submitted time and execution time is given by the

following table, calculated using the first-come, first-served scheduling algorithm， shortest job first algorithm and non-preemptive priority scheduling algorithms, the average waiting time in single channel program environment, and pointed out that the scheduling order and the turnaround time of the process d in each of the scheduling algorithm. And according to the average waiting time, what conclusion can get?(priority: c>d>b>a)（10 points）

Job number	Submit time (hours)	Execution time (hours)
a	8:00	2
b	8:20	1
c	8:40	0.5
d	8:50	0.4

答案：采用 FCFS 调度算法：
平均等待时间是：（0+100+140+160）/4=100（minutes）
进程调度顺序是：a-b-c-d
进程 d 的周转时间：184 minutes
采用 SJF 调度算法：
平均等待时间：（0+70+104+154）/4=82(minutes)
进程调度顺序是：a-d-c-b
进程 d 的周转时间：94minutes
采用非抢占优先级调度算法：
平均等待时间：（0+80+100+154）/4=83.5(minutes)
进程调度顺序是：a-c-d-b
进程 d 的周转时间：124minutes
结论：相同的进程，相同的进程提交时间，一般短作业优先调度算法的平均等待时间最短，周转时间也是最短的。