# 北京邮电大学 2024—2025 学年第一学期

## 《操作系统》期中考试试题

| 考试注意事项 | 一、学生参加考试须带学生证或学院证明，未带者不准进入考场。学生必须按照监考教师指定座位就坐。<br>二、书本、参考资料、书包等物品一律放到考场指定位置。<br>三、学生不得另行携带、使用稿纸，要遵守《北京邮电大学考场规则》，有考场违纪或作弊行为者，按相应规定严肃处理。<br>四、学生必须将答题内容做在试题答卷上，做在草稿纸上一律无效。<br>**五、学生必须用钢笔和签字笔答题，不得使用铅笔和圆珠笔答题；表格需要画出表格线。** |
|---|---|

| 考试课程 | 操作系统 | | | 考试时间 | | | 2024 年 11 月 日 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **题号** | **一** | **二** | **三** | **四** | **五** | **六** | **七** | **八** | **九** | **十** | **总分** |
| **满分** | **14** | **6** | **20** | **20** | **20** | **20** | | | | | **100** |
| 得分 | 13 | 6 | 20 | 12 | 20 | 17 | | | | | 88 |
| 阅卷教师 | | | | | | | | | | | |

**1. (14 points) Choose the best answer.**

B (1) **Modern operating systems are** B **driven. If there are no processes to execute, no I/O devices to service, and no users to whom to respond, an operating system will sit quietly, waiting for something to happen.**

**A. user B. interrupt C. device D. hardware**

C (2) **The interrupt mechanism is used by operating system to handle the following events except _____.**

~~**A. I/O completion**~~ ~~**B. dividing by zero**~~

**C. calling a procedure D. virtual memory paging**

D (3) **If a system can deal with 4 interactive processes, 6 real-time processes, 2 batch processes in 20ms, then the throughput of this system is_____.**

**A. 6/s B. 36/s C. 60/s D. 600/s**

B (4) **Which of the following statement is correct? _____**

**A. More instructions can be executed in user mode than in kernel mode.**

**B. We can switch from user mode to kernel mode through software interrupt traps.**

**C. The dual mode can prevent the process from entering the loop state.**

**D. Privileged instructions refer to the instructions that can be used by user mode processes.**

C (5) **Which of the following system has the strict time constraint? _____**

~~**A. distributed system**~~ **B. time-sharing system**

**C. real time system** ~~**D. interactive system**~~

C (6) **_____ is not included in the context of process?**

~~**A. PCB**~~ ~~**B. code**~~ **C. kernel stack** **D. interrupt vector**

B (7) _____ is the interval from the time of submission of a process to the time of completion.
A. Waiting time B. Turnaround time C. Response time D. Throughput

C (8) _____is the amount of time a process spent waiting in the ready queue.
A. Throughput B. Response time C. Waiting time D. Turnaround time

B (9) Which of the following migrations is impossible? _____
A. ready→running ~~B. ready→waiting~~ C. running→ready D. running→waiting

C (10) A starvation-free scheduling policy guarantees that no process waits indefinitely for service. Which of the following scheduling policies is starvation free? _____
A. Shortest Job First B. Priority C. Round Robin D. None of the above

B (11) In multiprogramming system, in order to guarantee the integrality of shared variable, processes should enter their critical section mutual exclusively.
Critical section refers to _____ .
A. synchronous mechanism B. a code segment
~~C. a data segment~~ ~~D. a buffer~~

C (12) A deadlock situation can arise if the four necessary conditions hold simultaneously in a system. Which one of the following is not the necessary conditions? _____
A. mutual exclusion B. hold and wait C. preemption D. circular wait

A (13) In operating systems, the semaphore stands for instances of resource, it is an integer variable relevant to a queue, its value can only be changed by operation wait() and signal(). If a semaphore S is initialized to 10, now its value is 2, how many processes is or are waiting in the queue relevant to S. _____
A. 0 B. 1 C. 2 D. 8

B (14) Which handling procedures of the following situations will not switch into kernel mode?_____
~~A. system calls~~ B. procedure calls ~~C. interrupts~~ D. traps

2. (6 points) In a system with 8 processors, there are 30 concurrent processes sharing a type of resource based on a semaphore S, if at most 4 processes are allowed to enter their critical sections to use the resource, then answer the following questions.

(1) (3 points) What are the maximum numbers of processes in ready, running, and waiting state?

Ready: 22 Running: 8 Waiting: 30

(2) (3 points) What are the initial, maximum, and minimum values for the semaphore *S* respectively?

initial value: ~~30~~ 4 maximum value: ~~30~~ 4 minimum value: ~~0~~ -26

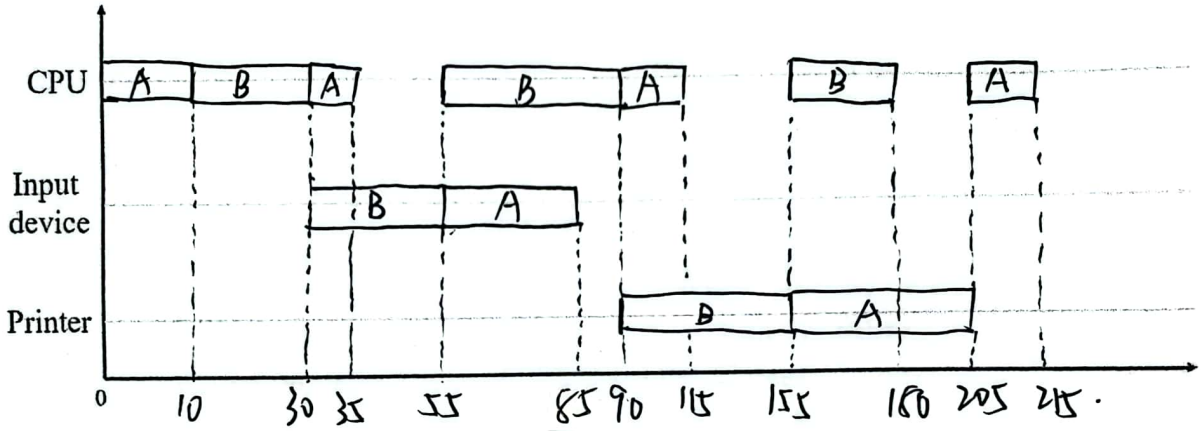
3. (20 points) In a computer system with only one CPU, one input device and one printer. Processes A and B enter the system sequentially at time 0 and time 10, and B has a higher priority. The execution tracks of A and B are as follows:

A: CPU burst lasting 15ms, then I/O burst of 30ms on the input device, and then CPU burst lasting 25ms, then I/O burst of 50ms on the printer, and then CPU burst lasting 10ms, exiting.

B: CPU burst lasting 20ms, then I/O burst of 25ms on the input device, and then CPU burst lasting 35ms, then I/O burst of 65ms on the printer, and then CPU burst lasting 25ms, exiting.

Answer the following questions:

(1) Suppose that preemptive priority scheduling algorithm is employed, draw the Gantt chart to describe the resource usage of A and B on the CPU, the input device and the printer.




(2) Calculate the waiting time and turnaround time for process A and B respectively.

| | waiting time(ms) | turnaround time(ms) |
|---|---|---|
| for process A | 85 | 215 |
| for process B | 0 | 170 |

(3) Calculate CPU utilization during this period.

$$\frac{35+60+25+10}{215} \times 100\% = 60.4\%$$

4. (20 points) Consider the following set of processes, their arrival time, CPU burst time, and priority numbers are as following. The length of the CPU burst given in milliseconds, and a smaller priority number implies a higher priority.

| Process | Arrival Time | CPU Burst Time (ms) | Priority number |
|---|---|---|---|
| P1 | 10 | 10 | 5 |
| P2 | 11 | 9 | 3 |
| P3 | 12 | 7 | 7 |
| P4 | 13 | 5 | 2 |

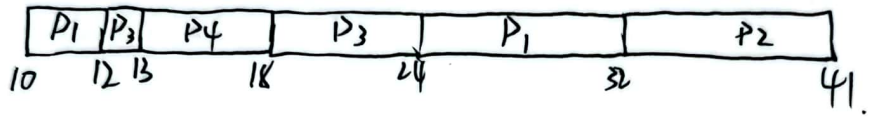
(1) Suppose that SJF scheduling algorithm is employed,

(a) Draw a Gantt chart illustrating the execution of these processes;

(b) Calculate the average turnaround time.

Answer:

(a)




(b)

| turnaround time (ms) | | | | average turnaround time (ms) |
|---|---|---|---|---|
| P1 | P2 | P3 | P4 | |
| 22 | 30 | 12 | 5 | 17.25 |

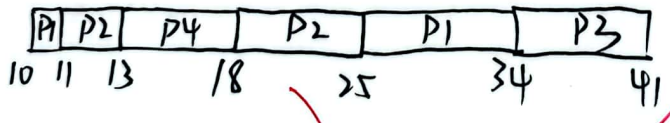
(2) Suppose that priority-based preemptive scheduling is employed,

(a) Draw a Gantt chart illustrating the execution of these processes;

(b) Calculate the average waiting time.

Answer:

(a)




(b)

| waiting time (ms) | | | | average waiting time (ms) |
|---|---|---|---|---|
| P1 | P2 | P3 | P4 | |
| 14 | 5 | 22 | 0 | 10.25 |

**5. (20 points) There is only one doctor in a clinic, and only one patient can be treated at a time. There are 10 chairs in the waiting room. Patients come to the clinic for medical treatment. If no patient is receiving medical treatment, they can directly enter the consulting room for medical treatment. If there is patient receiving medical treatment and there are still empty chairs in the waiting room, they can sit on the chairs and wait in line, otherwise they will leave and come back later..**

**Please use the semaphore mechanism to code the doctor process and the patient process.**

**Answer the following questions:**

**(1) Define necessary semaphores and variables, and assign them initial values;**

4

```
int count = 0;        计数器 patient.
semaphores doctor = 1,    医生是否空闲
           patients = 0,  是否有patients
           mutex = 1      互斥 count.
```

**(2) Write the code structure of doctor process and patient process.**

16

```
doctor:
while (1) {
    wait(patients);
    treat patients;
    signal(doctor);
}
```

```
patient:
while (1){
    wait(mutex);
    if (count == 11) {
        signal(mutex);
        exit();
    }
    count++;
    signal(patients);
    signal(mutex);
    wait(doctor);
    Get treated;
    wait(mutex);
    count--;
    signal(mutex);
}
```

6. (20 points) Consider a system with 3 resources types (A, B, and C) and 5 processes (P1, P2, P3, P4, and P5). The snapshot at time T0 is showed in the following table.

| Process | Max | | | Allocation | | | Available | | |
|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | A | B | C | A | B | C |
| P1 | 5 | 5 | 9 | 2 | 1 | 2 | 2 | 3 | 3 |
| P2 | 5 | 3 | 6 | 4 | 0 | 2 | | | |
| P3 | 4 | 0 | 11 | 4 | 0 | 5 | | | |
| P4 | 4 | 2 | 5 | 2+2 | 0+3 | 4+3 | | | |
| P5 | 4 | 2 | 4 | 3 | 1 | 4 | | | |

**Assume the system uses Banker's algorithm to avoid deadlock.**

**(1) (4 points) How many instances are there for each type of resources? Calculate matrix Need.**

A: 2+2+4+4+2+3 = 17

B: 3+1+1 = 5

C: 3+2+2+5+4+4 = 20

| | A | B | C |
|---|---|---|---|
| P1 | 3 | 4 | 7 |
| P2 | 1 | 3 | 4 |
| P3 | 0 | 0 | 6 |
| P4 | 2 | 2 | 1 |
| P5 | 1 | 1 | 0 |

**(2) (6 points) Is the state at T0 safe? If yes, give the safety process sequence.**

work

| A | B | C | |
|---|---|---|---|
| 2 | 3 | 3 | P4 |
| 4 | 3 | 7 | P2 |
| 8 | 3 | 9 | P1 |
| 10 | 4 | 11 | P3 |
| 14 | 4 | 16 | P5 |
| 17 | 5 | 20 | |

(2) 是安全状态

P4→P2→P1→P3→P5 —2

**(3) (3 points) At time T0, can the request for resources (0, 3, 4) by P2 be granted? Why?**

work

A B C

2 3 3

故不能满足，因为 (0,3,4) > (2,3,3)

—1

(4) (4 points) Then based on (3), can the request for resources (2, 0, 1) by P4 be granted? Why?

work

| A | B | C |
|---|---|---|
| 2 | 3 | 3 |
| 0 | 3 | 2 |
| 4 | 3 | 7 |
| 8 | 3 | 9 |
| 10 | 4 | 11 |
| 14 | 4 | 16 |
| 17 | 5 | 20 |

满足(2,0,1)
P4 true.
P2 true
P1 true
P3 true
P5 true

故可以满足P4 (2,0,1)

(5) (3 points) Then, based on (4), can the request for resources (0, 2, 0) by P1 be granted? Why?

work

| A | B | C |
|---|---|---|
| 0 | 3 | 2 |
| 0 | 1 | 2 |

满足(0,2,0)
无法Finish任何一个process
所以无法满足 P1(0,2,0)