

國立中山大學 115 學年度 碩士班考試入學招生考試試題

科目名稱：作業系統與資料結構【資工系碩士班甲組】

— 作答注意事項 —

考試時間：100 分鐘

- 考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- 答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，請衡酌作答。
- 答案卡請以 2B 鉛筆劃記，不可使用修正液（帶）塗改，未使用 2B 鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，後果由考生自負。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶書籍、紙張（應考證不得做計算紙書寫）、具有通訊、記憶、傳輸或收發等功能之相關電子產品或其他有礙試場安寧、考試公平之各類器材入場。
- 試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。
- 試題採雙面列印，考生應注意試題頁數確實作答。
- 違規者依本校招生考試試場規則及違規處理辦法處理。

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題號：434003

※本科目依簡章規定「不可以」使用計算機(問答申論題)

共 2 頁第 1 頁

1. (20%) Fill-in questions (2 points each)
 - (a) The number of processes currently in memory is known as the degree of ____.
 - (b) The modify bit (also called ____ bit) is set when page content is changed.
 - (c) The ____ is a module in the CPU-scheduling function, which provides the control of a CPU core to the process selected by the CPU scheduler.
 - (d) Any solution to the ____ problem must satisfy three requirements of mutual exclusion, progress, and bounded waiting.
 - (e) The main mass-storage system is secondary storage, which is usually provided by hard disk drive devices and ____ memory devices.
 - (f) To encapsulate details and oddities of different I/O devices, the kernel of an operating system is structured to employ device-____ modules.
 - (g) Among all necessary deadlock conditions, the condition of ____ implies the condition of hold and wait.
 - (h) File is a ____ collection of related information that is recorded on secondary storage.
 - (i) The ____ principle says that at any time, a process can access only resources that it currently requires to complete its task.
 - (j) Breach of ____ means unauthorized reading of data.
2. (a) (6%) What are three cases that cause a running process to give up the CPU core involuntarily? Please also mention the queue it will be placed in.
(b) (4%) Explain warm cache from the perspective of processor affinity.
3. (a) (6%) Please give three common ways to handle a deadlock problem in operating systems.
(b) (4%) Explain copy-on-write from the perspective of memory management.
4. (10%) What are the five steps involved in a typical sector-sparing transaction?
5. What is printed by each of the following C programs?
 - (a) (5%)

```
int x = 12;
int y = 25;
printf("%d\n", x ^ y & ~x | y << 2);
```

// ^: bitwise XOR; &: bitwise AND; ~: bitwise NOT; |: bitwise OR; <<: left shift
 - (b) (5%)

```
int mystery(int *p, int n) {
    static int count = 0;
    count++;
    if (n <= 0) return count;
    if (*p > 10)
        return *p + mystery(p + 1, n - 1);
    else
        return mystery(p + 1, n - 1);
}

int main() {
    int arr[] = {15, 5, 20, 8, 30};
    printf("%d\n", mystery(arr, 3));
    return 0;
}
```

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6. (10%) Given the inorder traversal ABCDEFGHIJ and the postorder traversal ABDCGIHJFE of a binary tree, determine the preorder traversal.

7. (10%) Consider a hash table of size $M = 11$, where each bucket can hold only one key. The table uses double hashing. The primary hash function is $h_1(k) = (k \bmod 11)$, and the secondary hash function is $h_2(k) = 7 - (k \bmod 7)$. Insert the keys 11, 33, 66, 7, 77 (in this order) into the empty hash table. Show the final state of the hash table after all insertions.

8. Consider the adjacency matrix of an undirected graph as follows:

	A	B	C	D	E	F
A	0	2	4	0	5	0
B	2	0	1	9	0	7
C	4	1	0	0	6	10
D	0	9	0	0	0	8
E	5	0	6	0	0	3
F	0	7	10	8	3	0

(a) (8%) Starting from vertex A, show the order in which the edges are added into the minimum spanning tree using Prim's algorithm. Use the weight to represent edges in your answer.

(b) (2%) Let V and E denote the number of vertices and edges in a graph, respectively. What is the time complexity of Prim's algorithm when it is implemented using an adjacency list and a binary heap?

9. For each of the following sorting algorithms, state its worst-case time complexity using Big-O notation (e.g., $O(n)$).

- (a) (2%) Bubble sort
- (b) (2%) Insertion sort
- (c) (2%) Quick sort
- (d) (2%) Merge sort
- (e) (2%) Heap sort