115CC01

國立臺北科技大學 115 學年度碩士班招生考試

系所組別：2210 電子工程系碩士班甲組

第一節　計算機概論　試題

注意事項：

1.本試題共 10 題，各題配分列於題後，共 100 分。
2.不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3.全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. (15%) Design an algorithm to insert the following sequence into a Red-Black Tree, maintaining all Red-Black Tree properties after each insertion. Draw the final tree structure and explain the adjustments made at each step. The sequence is [41, 38, 31, 12, 19, 8].
   (1) State the five properties of a Red-Black Tree. (5%)
   (2) Describe each insertion process on detail and indicate whether any Red-Black Tree property is violated. If a violation occurs, identify the violated property and explain how to fix it. (6%)
   (3) Draw the final tree, which must satisfy all Red-Black Tree properties. (4%)
2. (10%) The system has 3 resource types (A, B, C) with total instances, such as A = 10, B = 5, and C = 7. There are 5 processes (P0 ~ P4) with the following Max and Allocation matrices, as listed at Table 1. Available resources are A = 3, B = 3, and C = 2. Please use the Banker's algorithm to determine whether the system is in a safe state and provide the safe sequence (if any) **included the calculation process**.

Table 1

Process	Allocation	Max
P0	0 1 0	7 5 3
P1	2 0 0	3 2 2
P2	3 0 2	9 0 2
P3	2 1 1	2 2 2
P4	0 0 2	4 3 3

3. (10%) The system contains four processes with the following arrival times and CPU burst times, as listed at Table 2. For each of the following scheduling algorithms, draw the Gantt chart and compute the average waiting time.
   (1) First-Come First-Served (FCFS). (3%)
   (2) Preemptive Shortest Job First (Shortest Remaining Time First, SRTF). (4%)
   (3) Round Robin (Time Quantum = 3). (3%)

Table 2

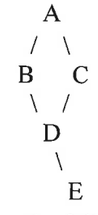
Process	Arrival Time	CPU Burst
P1	0	8
P2	1	4
P3	2	9
P4	3	5

4. (6%) Design a divide-and-conquer algorithm to find both the maximum and minimum elements in an array of size n by using the minimum number of comparisons.
   (1) Calculate the time complexity (3%)
   (2) Calculate the number of comparisons (3%).
5. (10%) Given the following set of activities with start time and finish time, as listed at Table 3. Apply the Greedy Activity Selection algorithm step by step.
   (1) Explain the reasoning at each step (6%).
   (2) Provide the final selected set (4%).

Table 3

Activity	Start Time	Finish Time
A1	1	4
A2	3	5
A3	0	6
A4	5	7
A5	8	9
A6	5	9

6. (12%) Consider the following undirected graph. Perform graph traversals starting from node A. Assume that adjacent vertices are visited in alphabetical order (A→Z).



Answer the following questions:
(1) List the visiting order of BFS (Breadth-First Search). (3%)
(2) Draw the BFS tree. (3%)
(3) List the visiting order of DFS (Depth-First Search). (3%)
(4) Draw the DFS tree. (3%)

注意：背面尚有試題

7. (10%) A system uses demand paging with 3 page frames. Given the following page reference string: 7, 0, 1, 2, 0, 3, 0, 4, 2, 3, 0, 3. Please answer the following questions:
   (1) Calculate the number of page faults by using FIFO. (5%)
   (2) Calculate the number of page faults by using LRU. (5%)
8. (12%) A disk system has 200 tracks (0–199). The disk head is currently at track 53, and the request queue: 98, 183, 37, 122, 14, 124, 65, 67. Assume the initial head movement direction is toward higher-numbered tracks.
   (1) List the service order by using the SCAN algorithm. (3%)
   (2) Calculate the total head movement of SCAN. (3%)
   (3) List the service order by using the FCFS algorithm. (3%)
   (4) Calculate the total head movement of FCFS. (3%)
9. (5%) Given the following weighted directed graph with positive edge weights. Vertices: V = {A, B, C, D, E}. Edges and weights: A→B: 4, A→C: 2, B → C: 1, B→D: 5, C→D: 8, C→E: 10, and D→E: 2. Write the shortest path from A to E by using Dijkstra's algorithm.
10. (10%) Consider a hash table of size m = 11 with the hash function: $h(k) = k \bmod 11$. Insert the following keys {21, 32, 43, 54, 65, 76} in order by using linear probing for collision resolution. Answer the following:
    (1) Show the probing sequence for each insertion. (4%)
    (2) Draw the final hash table. (3%)
    (3) Compute the average number of probes for successful search. (3%)