

1. Consider a memory system with the following parameters:

T_c = Cache access time = 100 ns

(20%) T_m = Main Memory access time = 1200 ns

H = Hit ratio = 0.95

C_c = Average cost per bit, Cache = 0.01 $\$/bit$

C_m = Average cost per bit, main memory = 0.001 $\$/bit$

- (1) What is the cost of a 1 MByte main memory?
- (2) What is the cost of a 1 MByte main memory using cache technology?
- (3) Design a main memory/cache system with 1 MByte of main memory whose effective cycle time is no more than 10% greater than the cache memory cycle time. What is its cost?

2. (1) In virtually all systems that include DMA modules, DMA access to main memory is given higher priority than CPU access to main memory. Why?

- (15%) (2) A DMA module is transferring characters to memory using cycle-stealing, from a device transmitting at 9600 bps. The CPU is fetching instructions at a rate of 1 million instructions per second (1 MIP). By how much will the processor be slowed down due to the DMA module?

3. About the multiprocessing, describe ^{and} explain in details:

- (15%) (1) the classification
(2) the organization
(3) Time-shared bus
(4) Multiport memory

4. For the dynamic memory management, describe and explain in details:

- (15%) (1) In what situation, we need this kind of techniques?
(2) First fit
(3) Best fit
(4) Worst fit

5. Assume that an array of 10 integers contains the elements
1, 3, 7, 15, 21, 22, 36, 78, 95, 106

Use the recursive binary search algorithm listed in the following
to find each of the following items in the array

- (1) 1 (2) 20 (3) 36

(20%)

```

1  if low > high
2  then binsrch := 0
3  else begin
4      mid := (low + high) div 2 ;
5      if x = a[mid]
6          then binsrch := mid
7      else if x < a[mid]
8          then search for x in a[low] to a[mid-1]
9      else search for x in a[mid+1] to a[high]
10 end { else begin }
    
```

6. The figure shown is the architecture
of Tandem Nonstop System
(A kind of fault-tolerant
system).

(15%)

- (1) Explain the operation principle
of the whole system.
(2) Describe the backup process
strategy of Tandem system.

