

- 1、For the addition operation of signed binary numbers, negative numbers are represented in two's complement format. Give an example in which the addition of two negative numbers results in overflow. (6%) Explain how to detect overflow. (2%)
- 2、Using JK flip-flops and logic gates, design a counter which will cycle through the sequence 1, 3, 5, 7, 0, 2, 4, 6, 1, 3, ... The design should be as simple as possible in terms of gate count. There is no limitation on the fan-in of each logic gate. (12%)
- 3、Suppose a cache with a total capacity of 4 Mbytes has an 8-way set associative organization. Each line (block) is 16 bytes. The cache is byte-addressable (each byte can be accessed individually). If the address generated by the computer system is 32 bits in length, indicate the fields and number of bits in each field of the address. (10%)
- 4、The in-order traversal of a binary tree is ACDFHIJK, whereas its post-order traversal is ADCIHKJF. Show the structure of the binary tree. (6%) Describe two applications of binary tree traversal. (4%)
- 5、Three processes arrive for execution at the times indicated below together with the required service time of each:

<u>Process</u>	<u>Arrival Time</u>	<u>Service Time</u>
A	0.0	8
B	2.0	4
C	3.0	2

If the operating system uses non-preemptive scheduling and makes all decisions based on the information available at the time the decision is made. What is the average turnaround time for these processes with (a) FCFS scheduling algorithm; (b) SJF scheduling algorithm? (10%)

- 6、Suppose all frames of a virtual memory system are initially empty, so that the first reference to each unique page will result in one page fault. Consider the following page reference string:

1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6.

Assume there are four frames. Calculate the number of page faults for the following replacement algorithms: (a) LRU; (b) FIFO; (c) Optimal. (12%)

- 7、Two types of packet networks are commonly used: datagram and virtual circuit. Describe the differences of the two. (8%)
- 8、Coding schemes NRZ, NRZI (invert on 1), Manchester, and differential Manchester are applied to the bit stream 10101110. Suppose initially the level is low. Show the waveform for each coding scheme. (8%) For Manchester coding, which bit pattern gives rise to the most level transitions? (2%)
- 9、Under proper assumptions, the throughput  $S$  of an Aloha network with traffic load  $G$  can be approximated as  $S = Ge^{-2(1+a)G}$ , and that of a slotted Aloha network as  $S = Ge^{-(1+a)G}$ , where  $a$  can be viewed as a constant. Find the maximum throughput for each of the protocols as a function of  $a$ . (10%)
- 10、Briefly answer the following questions:
  - (a) The two most popular hardware description languages. (2%)
  - (b) Order of magnitude (in power of 10) of the number of IP addresses in IPv6. (2%)
  - (c) IEEE standards for wireless LAN and WiMax. (2%)
  - (d) The high-k element used in Intel Core Extreme processor. (2%)
  - (e) The terms from which the newly popular *podcast* is derived. (2%)