1. Use Booth algorithm to calculate the following: (20%)

a. multiplicant × multiplier = 10111 × 10011 = -9 × -13 = 117

Iteration	Step	Multiplicand	Product
0	initial values	10111	00000 10011 0 −10111
1		10111	
2		10111	
3		10111	
4		10111	
5		10111	***00011 10101*** 1

b. Prove the correctness of the Booth algorithm. The main idea of Booth algorithm is that a sequence of k 1's (k additions) is replaced by one addition and one subtraction. You must explain why only one subtraction (without subtraction) is needed for the last sequence of 1's when multiplier is negative.

2. What is the biased single precision IEEE 754 floating point format of 0.9375? What is purpose to bias the exponent of the floating point numbers? (8%)

3. Why do the ripple carry adders perform additions in a sequential manner? Carry-lookahead adder is one of the fast-carry schemes to improve the adder performance over ripple carry adders. What is the principle of these fast-carry schemes? Briefly explain. (7%)

(背面仍有題目,請繼續作答)

4. Assume the following: (15%)

(1) k is the number of bits for a computer's address size (using byte addressing)

(2) S is cache size in bytes

(3) B is block size in bytes, $B = 2^b$

(4) A stands for A-way associative cache

Figure out the following quantities in terms of S, B, A, and k:

a. the number of sets in the cache

b. the number of index bits in the address, and

c. the number of bits needed to implement the cache

5. Four processes, W, X, Y and Z, arrive at a computer at time 2, 3, 0 and 5, respectively. The CPU burst time of them is listed in the right table (time unit: milliseconds):

process	burst time
W	5
X	2
Y	8
Z	7

Please ignore process switching overhead and assume that only a process runs at a time. Determine the average waiting time and average turnaround time for each of the following scheduling algorithms: (a) First-come, first-served (FCFS) scheduling, (b) Preemptive shortest-job-first (SJF) scheduling, (c) Nonpreemptive shortest-job-first scheduling, and (d) Round-Robin scheduling (time quantum is 4, CPU is equally shared by processes). (24%)

Draw the following table and fill in the time for each algorithm in your answer sheet.

Algorithms	average waiting time	average turnaround time
(a) FCFS		
(b) Preemptive SJF		
(c) Nonpreemptive SJF		
(d) Round-Robin		

6. Suppose a system contains three types of resources and five processes. Three resources, X, Y and Z have 5, 2, and 7 instances, respectively. The snapshot of the system is as follows:

Process	Current Allocation			Maximum Demand		
	X	Y	Z	X	Y	Z
P0	1	1	1	3	1	1
P1	1	0	0	1	0	2
P2	0	0	1	1	1	2
P3	0	1	1	1	1	2
P4	3	0	2	4	1	3

Answer the following questions using the banker's algorithm：(14%)

(a) Is the system in a safe state ? If yes, list all possible safe sequences.

(b) If a request from process 2 arrives for resource (0,0,1), can the request be granted immediately ? Why?

(c) If a request from process 1 arrives for resource (0,0,1), can the request be granted immediately ? Why?

7. (a) What is convoy effect? (4%)

(b) What is memory thrashing? (4%)

(c) What is race condition for critical section problem? (4%)