1. Explain and differentiate (make an example, if necessary) the following terms :
15% (a) Program Counter and Location Counter
   (b) Absolute Expressions and Relative Expressions
   (c) Program Block and Control Section
   (d) Linking Loader and Linkage Editor
   (e) Nested Macro Definition and Recursive Macro Expansion

2. Briefly answer the following questions :
15% (a) What are the major data structures used by a two-pass assembler ?
   (b) What is the main advantage by using reference numbers for code modification ?
   (c) Discuss two methods for specifying relocation as part of the object program.
   (d) What main functions does a Macro Processor involve ?
   (e) What is the most obvious disadvantage of the absolute loader ?

3. Using the following definition, expand the following macro invocation statement :
8%

```
     SUM    MACRO    &IC
            LDA      P&IC->1
            ADD      P&IC->2
            ADD      P&IC->3
            STA      P&IC->R
            MEND
     (a)  SUM   X
     (b)  SUM   ALPHA
```

4. Using the following **BNF** grammar to construct a parse tree for the statement below.
10%
```
<id-list> ::= id | <id-list>, id
<assign>  ::= id := <exp>
<exp>     ::= <term> | <exp> * <term> | <exp> DIV <term>
<term>    ::= <factor> | <term> + <factor> | <term> - <factor>
<factor>  ::= id | int | (<exp>)

statement  →  SEGAMA := ALPHA * BETA DIV GAMMA - 100
```

5. Produce a sequence of quadruples for the following program fragment:
8%
```
READ (X,Y):
Z := 3 * X - 5 * Y + X * Y;
```

6. (a) What is *critical section* ?　How can you solve the *critical section* problem ?
16% (b) What is *thrashing* ?　Briefly describe the cause of *thrashing*.
   (c) What are the necessary conditions which are in effect for a *deadlock* to exit ?
   (d) Explain the methods of *deadlock prevention.*

7. Consider the following snapshot at T_0 of a system:
12%

	Allocation			Max			Available		
	A	B	C	A	B	C	A	B	C
P0	0	1	0	7	5	3	3	3	2
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			

Answer the following questions using the Banker's Algorithm:
(a) What is the content of the matrix *Need*?
(b) Is the system in a safe state?　If yes, list all possible safe sequences.
(c) If a request from process $P1$ arrives for (1,0,2), can the request be granted immediately?
   If yes, list the possible safe sequence.

8. Suppose that a disk drive has 200 cylinders, numbered 0 to 199. The drive is currently serving a request at cylinder 143, and
16% the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is
   86, 147, 91, 177, 94, 150, 102, 175, 130
   Starting from the current head position, what are the head movement sequences and the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests, for each of the following disk scheduling algorithms?

   (a) SSTF(shortest-seek-time-first)　　　(b) SCAN　　　(c) LOOK　　　(d) C-SCAN