1. Explain the following terminologies: (20%)
   (a). Instruction cycle (b). Multlist (c). Indirect addressing
   (d).Emulation (e). Virtual machine

2. Write a program (by FORTRAN or C language) to calculate the series approximation for EXP(x), x changes from 1.0 to 25.0 with step 1.0, where the last term of the desired accuracy EPS is less than 0.000001

$$EXP(x) = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots\cdots \quad (10\%)$$

3. Write a subroutine or procedure (by FORTRAN or C language) named FIND, FIND(AR, M, N, WANT, LOC), that looks up the value of WANT in the two-dimensional array AR. M is the number of rows in AR and N is the number of columns. If the desired value is found, LOC is set to the position of the count value on the column-major order. If the value is not found, then LOC is set to -1. (10%)

4. Designing a logic circuit for a two-bit comparator by using NAND gates only. (10%)

5. (a). Computing $(25)_{10}$ - $(14)_{10}$ with two's complement representation in 8-bits accumulator.(5%)
   (b). How to represent $(12.25)_{10}$ with normalized binary floating-point number in a 32-bits register. (5%)

6. (a). Describe how a stack is represented in memory. How are the PUSH and POP operations implemented ? (5%)
   (b). Give the rules for evaluating a postfix notation from infix notation by using a stack. (5%)

7. (a). What are the advantage and disadvantage of a doubly linked list over a singlely linked list ? (5%)
   (b). Write an algorithm and diagram to describe the process of inserting a cell (node) before a given cell in a doubly linked list. (5%)

8. The parenthesis notation of a tree is A(B(C(DE)F)G(H(IK)L(MN))), draw the tree and show the preorder and postorder traversals. (10%)

9. (a). What is hashing function ? describe its advantage. (5%)
   (b). How to solve the collision problem when using hashing function ? (5%)

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