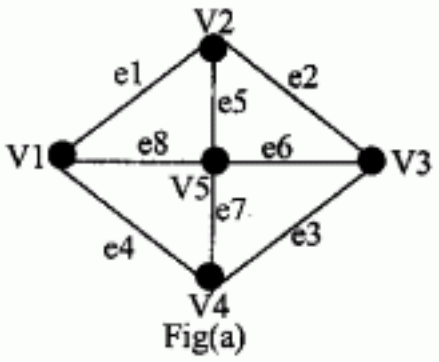
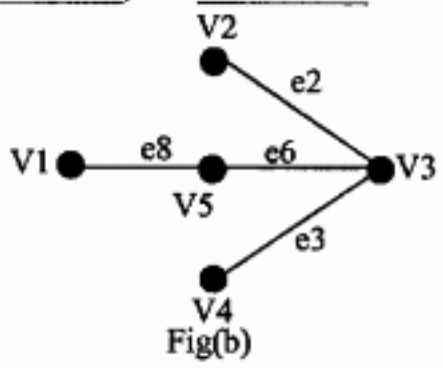
九十一學年度 資訊工程學 系（所） 組碩士班研究生招生考試

科目 基礎計算機科學 科號 2701 共 3 頁第 1 頁 *請在試卷【答案卷】內作答

1. (8%) Let Fig(a) be a graph and Fig(b) be its spanning tree. The fundamental circuit corresponding to the chord e1 is the circuit _____ and the other fundamental circuits are _____, _____, and _____.



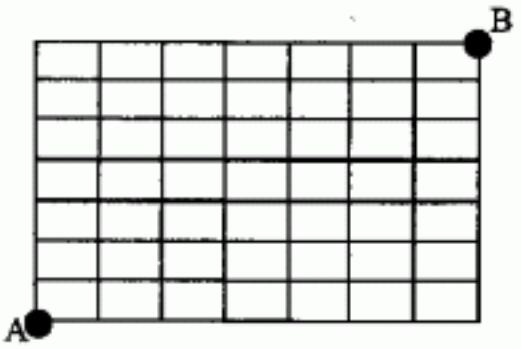
Fig(a)



Fig(b)

2. (10%) There are two restaurants next to each other. One has a sign that says "*Good food is not cheap*", and the other has a sign that says "*Cheap food is not good*". Are the signs saying the same thing? Why?

3. (7%) We will have *14! / (7! 7!)* ways to move from *A* to *B* by moving eastward and northward only. We ask now how many of these paths consist of four eastward moves and three northward moves. (By an eastward move, we mean a certain number of consecutive eastward steps. A northward move is defined similarly)



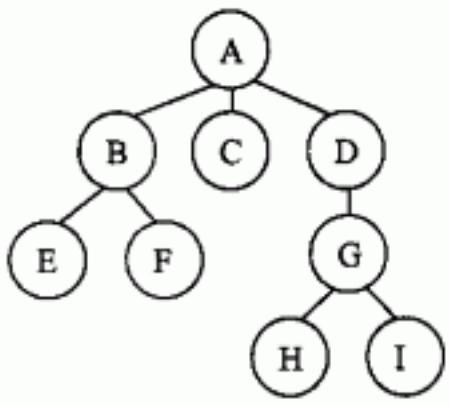
4. (10%) Consider the problem of the towers of Hanoi. There are totally three pegs and *N* disks. The disks are originally stacked on peg 1 with no disk resting upon a smaller one. The objective is to transfer the disks one at a time so that we end up with the original stack on peg 3. Peg 2 may be used as a temporary location for any disks, but at no time are we allowed to have a larger disk on top of a smaller one on any peg. Please answer the following questions regarding to the Hanoi tower problem.
   (a) Please model the complexity of the Hanoi tower problem (the number of moves needed for *N* disks) in terms of a linear recurrence equation.
   (b) Solve the linear recurrence equation above to get the number of moves needed for *N* disks. Note that you need to list your methods in solving the equation, step by step.

A sample code for the algorithm of Hanoi problems for your reference is listed below.

```
if N is 1 then
        Move disk 1 from the from peg to the to peg.
else
  begin
        Move N-1 disks from the from peg to the auxiliary peg using the to
        peg as a intermediary.
        Move disk N from the from peg to the to peg.
        Move N-1 disks from the auxiliary peg to the to peg using the from
        peg as an intermediary.
  end
```

5. (15%) Please answer the following questions for "relation" related to elementary mathematic concepts in discrete mathematic and algebra.
   (a) Please give your definition on "relation" used in algebra. Try to compare your definition of "relation" with "function" which is also used in math.
   (b) Explain what is the meaning of an "equivalence relation"?
   (c) Finite state machine is nowadays used frequently in a variety of areas in computer applications. For example, it's used in vendor machines, scanners and lexical analysis for compiler analysis, state transition machines in logic circuit designs, etc. Minimization of finite state machines to reduce the number of states is desired as it both increases the performance of systems and reduces the size of systems. Try to give an equivalence relation for finite state machines to model the problem of the minimization of finite state machines. Please justify your answer.
6. (4%) Suppose that it is known that the elements that will be put on a circular queue are all the same. Suggest a good way to implement the queue.

7. (8%)
   (a) (4%) Represent the following tree by a Binary tree representation.



   (b) (4%) In order to access the tree node quickly, the Binary tree is stored level-by-level in a one dimensional array *tree[1..1000]*. Give the array index for *G* and *I*.

8. (8%)
   (a) (4%) Describe a model for a gate-level circuit where a gate Ni has a delay Di.
   (b) (4%) Show how to find the longest delay of the circuit.

9. (5%) Construct Huffman Binary codes for the following 6 messages whose probabilities of appearance are *A=0.29, B=0.25, C=0.14, D=0.13, E=0.11 F=0.10*. Suppose that *E* is encoded as 010 and *D* is 101. What are *A* and *F* encoded?

10. (6%) *T* is a binary search tree with *n* nodes and the height of *T* is *O(logn)*. Assume that *H* is the height of *T* after we perform m operations on *T*. (The *m* operations can be any operations, such as insert, delete, search etc.). What is the worst case value of *H*? Justify your answer.

11. (6%) Let *A[1..j, 1..k]* be a two-dimensional array. Each element of *A* requires two bytes. Let *A[2,2]* be stored at 898 and *A[1,3]* be stored at 910. Assume that the memory is addressed by byte and the array is stored sequentially in memory.
    (a) (3%) What is the value of *j* ?
    (b) (3%) What is the address of *A[5,7]* ?

12. (13%) Please write a recursive algorithm to check if the given pre-order tree traversal sequence and the in-order tree traversal sequence belong to the same tree. The inputs of your algorithm are stored in two arrays *A[]* and *B[]* , corresponding to the preorder and in-order tree traversal sequences. The output of your algorithm should be "yes" or "no". Your algorithm should answer "yes" if and only if those two input sequences belong to the same tree. (Note: Non-recursive algorithm is not accepted.)