King Mongkut's University of Technology Thonburi
Final Exam of Second Semester, Academic Year 2009

COURSE CPE112 Discrete Mathematics for Computer Engineers
Computer Engineering Dept, 1st Yr.

Tuesday 9 March 2010 **09.00-12.00 h.**

Instructions

1. This examination contains 4 problems, 5 pages (including this cover page).
2. The answers must be written in the answer book.
3. Students are allowed to use calculators.
4. Students are allowed to use dictionaries or electronic dictionaries.
5. No books, notes, or any other documents can be taken into the examination room.

Students must raise their hand to inform to the proctor upon their completion of the examination, to ask for permission to leave the examination room. Students must not take the examination and the answers out of the examination room.

Students will be punished if they violate any examination rules. The highest punishment is dismissal.

This examination is designed by

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This examination is approved by the department of computer engineering

Associate Professor Dr. Tiranee Achalakul

1. Logic (14%)

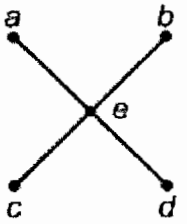
Translate the following English sentences into sentences in first-order predicate logic
Use predicate *study(X,Y)* which means that student *X* studies subject *Y*.

1.1) Dang studies English. (1 %)
1.2) Someone studies Economics. (1 %)
1.3) Dum studies some subject. (1 %)
1.4) There is some student who studies both English and Mathematics. (1 %)
1.5) Sombat studies every subject. (1 %)
1.6) Not every student studies Accounting. (1 %)
1.7) Everyone studies some subject. (2 %)
1.8) For each subject, there is someone who studies it. (2 %)
1.9) There is a student who studies every subject. (2 %)
1.10) There is a subject that everyone studies. (2 %)

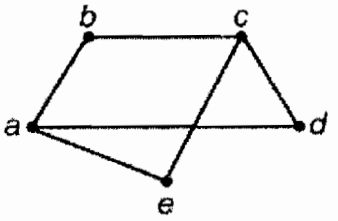
2. Graphs and Trees (40%)

2.1) Determine whether the following graph is bipartite. If it is bipartite, show the sets V_1 and V_2. (6%)

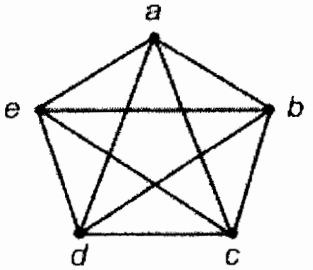
2.1.1) (1%)



2.1.2) (2%)



2.1.3) (3%)

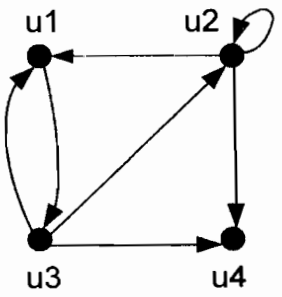


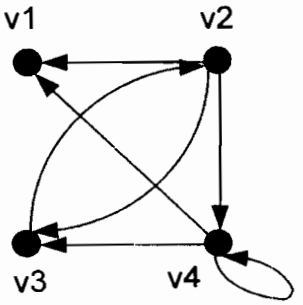
2.2) Determine whether the following pair of graphs is isomorphic. If it is isomorphic, show the function. (10%)

Definition The directed graph $G_1=(V_1,E_1)$ and $G_2=(V_2,E_2)$ are isomorphic if there is one-to-one and onto function $f:V_1\rightarrow V_2$ such that

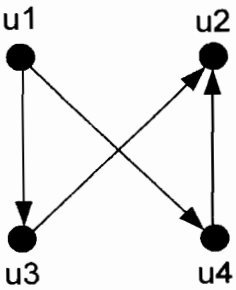
For all pairs of vertices a and b in V1, $(a,b) \in E_1$ iff $(f(a),f(b)) \in E_2$

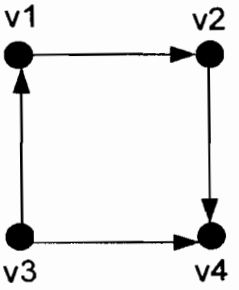
2.2.1) (3%)



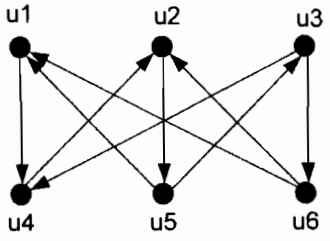


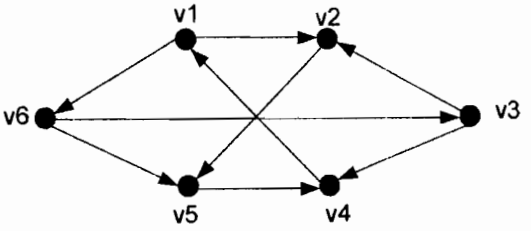
2.2.2) (3%)





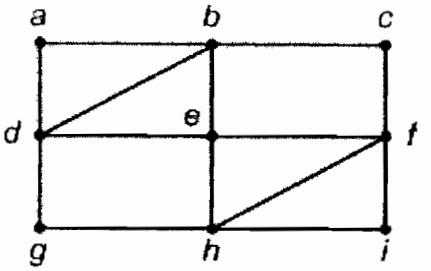
2.2.3) (4%)



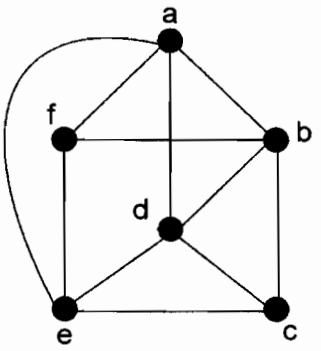


2.3) Euler Paths and Circuits (4%)

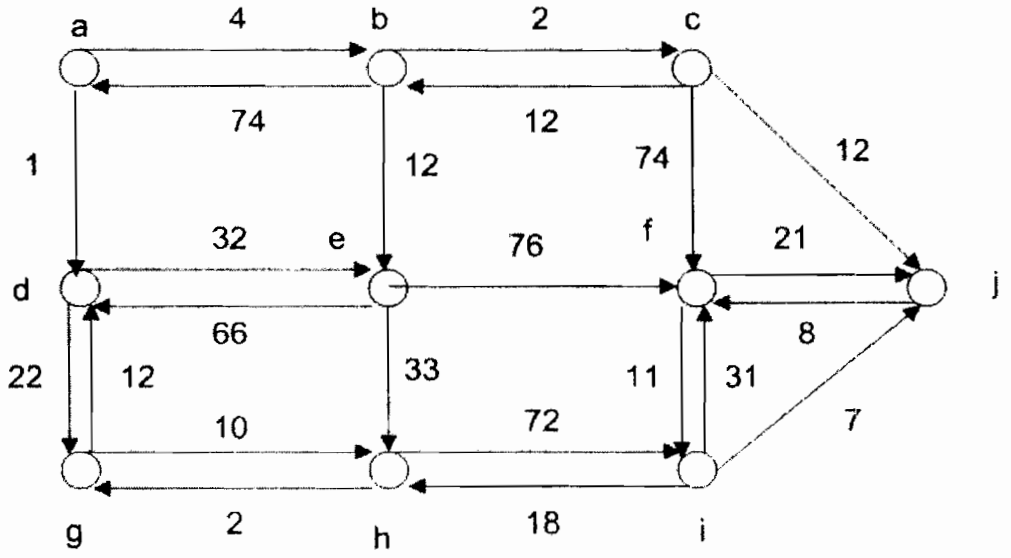
2.3.1) Determine whether the following graph has Euler circuit. If there is Euler circuit, show it. (2%)



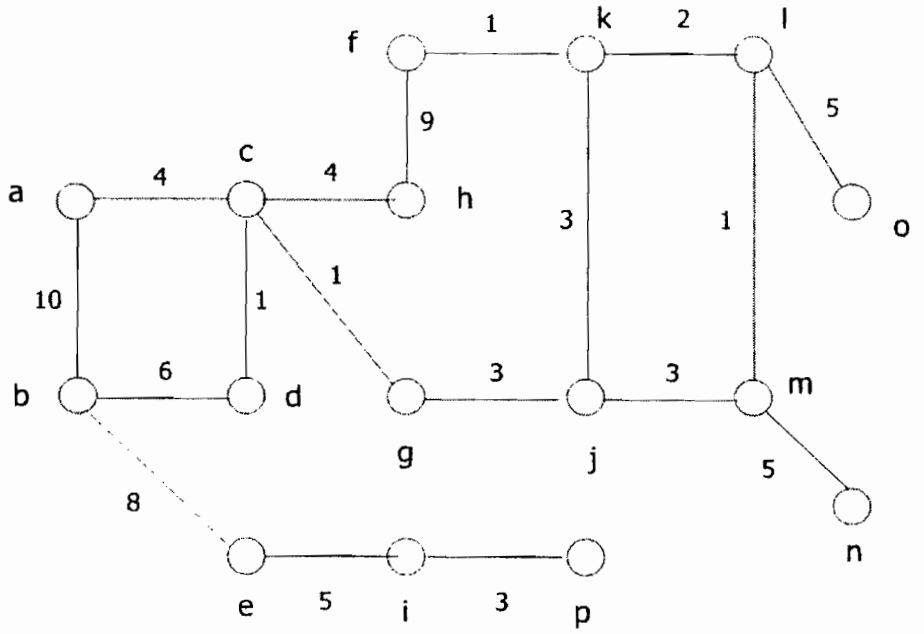
2.3.2) Determine whether the following graph has Euler circuit or path. If there is Euler circuit, show it. If there is Euler path, show it (2%)



2.4) Find the shortest path from *a* to *i* in the following graph by using Dijkstra's algorithm. Show a selected edge at each iteration. For example, at 1st iteration, (*a*,*d*) is selected. (10%)



2.5) Use Prim's algorithm to find a minimum spanning tree of the following graph and the starting node is *a*. Show a selected edge at each iteration. (10%).



3. Boolean Algebra (12%)

Find sum-of-product expansion of the following Boolean functions and then use Karnaugh Map technique to simplify them

3.1) $f(x,y,z) = y(\overline{xz}) + \overline{y}x + \overline{yz}$ (12%)

4. Automata (34%)

4.1) Write down regular expressions for the following languages. Let $\Sigma = \{0,1\}$

4.1.1) The set of strings that starts with 0 and ends with 1 (2%)
4.1.2) The set of strings that contain 000 as a substring. (2%)
4.1.3) The set of strings of two or more symbols followed by one or more 1s (3%)
4.1.4) The set of strings of length 6 that contain 000 as a substring (3%)

4.2) Design deterministic finite automata (DFA) which accepts the following languages. Let $\Sigma = \{0,1\}$

4.2.1) The set of strings that contain 000 as a substring. (12%)
4.2.2) The set of strings of two or more symbols followed by one or more 1s (12%)