

# King Fahd University of Petroleum and Minerals

College of Computer Science and Engineering  
Information and Computer Science Department

ICS 353-03: Design and Analysis of Algorithms

Spring 2006-2007

Quiz#5, Monday May 28, 2007.

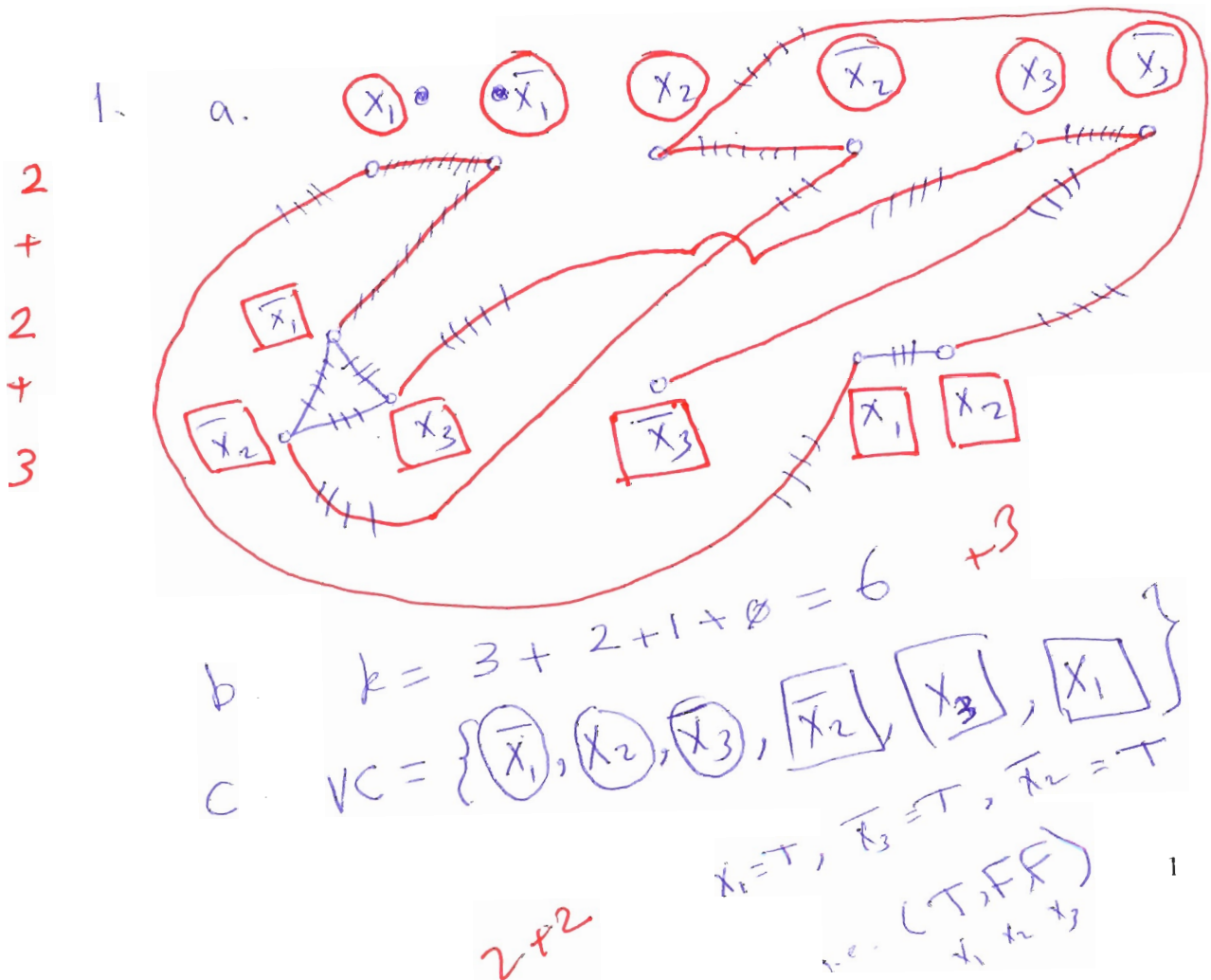
Name:

ID#:

1. (14 points) NP-Complete Problems Consider the following instance of Satisfiability:

$$(\overline{x_1} \vee \overline{x_2} \vee x_3) \wedge (\overline{x_3}) \wedge (x_1 \vee x_2)$$

- (7 points) Following the reduction method from satisfiability to vertex cover, transform the above formula into an instance of vertex cover for which the answer is yes if and only if the above formula is satisfiable.
  - (3 points) What is the size of the vertex cover,  $k$ , mapped by the reduction above?
  - (4 points) Find a vertex cover of your graph of size  $k$  and convert it into a satisfying assignment for the formula given above.
2. (6 points) Define what a standard Turing Machine is, describing the next-state function.



2. A Turing Machine  $M$  is a 6-tuple

$$M = (\Gamma, \beta, Q, \delta, S, h) \text{ where:}$$

$\Gamma$ : Tape alphabet, not containing  $\beta$ .

$\beta$ : Blank symbol

$Q$ : Set of states

$\delta$ : Next-state function

$S$ : Initial state

$h$ : Accepting halt state ( $h \in Q$ ).

Next state function:

$$\delta: (Q \times (\Gamma \cup \{\beta\})) \rightarrow (Q \cup \{h\}) \times (\Gamma \cup \{\beta\}) \times \{L, R\}$$

$\delta(q, a) = (q', a', C)$  means that if  $M$  is in state  $q$  & letter  $a$  is under tape head,

its control state enters state  $q'$ , writes letter  $a'$  & moves Left or Right according to whether  $C=L$  or  $C=R$ , respectively.