考生注意事項: 一、考試時間100分鐘。 二、應考人不得自行攜帶電子計算器,一律由本校統一提供。

試題一:〈每小題20分,共40分〉

有一線性規劃問題如下:  $Min Z = 18x_1 + 6x_2 - x_3$   $s.t. 2x_1 + x_2 - 2x_3 \ge 5$   $4x_1 + x_2 + x_3 \ge 15$   $x_1 \ge 0, x_2 \ge 0, x_3 \ge 0$ 假設  $y_1$ 、  $y_2$ 分別為上述第一及二條功能限制式所對應對偶問題的決策變數。 (1)請寫出上述問題之對偶問題(dual problem)。

(2)此對偶問題的最佳解為何?

試題二:〈 20 分〉

The payoff of the following 3×4 game is for A player. Please solve the problem graphically.

Strategies	Strategies of B player					
of A player	b1	b2	b3	b4		
al	6	3	-1	-2		
a2	3	4	6	5		
a3	-2	3	5	2		

The following **P** is a 3×3 transition matrix. Please determine the steady-state (long run) probabilities of three states,  $\pi_1$ ,  $\pi_2$  and  $\pi_3$ .

$$\mathbf{P} = \begin{bmatrix} 0.6 & 0.3 & 0.2 \\ 0.1 & 0.7 & 0.1 \\ 0.2 & 0.3 & 0.5 \end{bmatrix}$$

試題四: 〈 20 分〉

*True/False:* Indicate by "O" = "true" or "X" = "false." (each 2 points, total 20 points)

- 1. The system AX = b has no solution if A is singular and b is independent of A.
- \_\_\_\_\_ 2. A "pivot" in the simplex method corresponds to a move from one corner point of the feasible region to another.
- \_\_\_\_\_ 3. Adding constraints to an LP may improve the optimal objective function value.
- 4. If an artificial variable is nonzero in the optimal solution of an LP problem, then the problem has no feasible solution.
- 5. If you make a mistake in choosing the pivot column in the simplex method, the next basic solution will be infeasible.
- 6. If a primal minimization LP problem has a cost which is unbounded below, then the dual maximization problem has an objective which is unbounded above.
- \_\_\_\_\_7. The optimal values of the primal and dual LP problems, if they exist, must be equal.
- 8. One advantage of the revised simplex method is that it does not require the use of artificial variables.
- 9. The two-phase method solves for the dual variables in Phase I, and then solves for the primal variables in Phase II.
- \_\_\_\_\_ 10. In a transportation problem, if the current dual variables U2=3 and V4=1, and C24=2, then the current basic solution cannot be optimal.

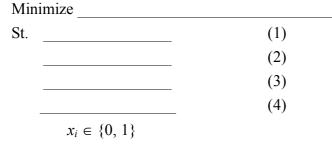
## 試題五:〈 40 分〉

## Integer Programming Model Formulation. (Each 8 points, total 40 points)

The NCUT is to form a committee to handle the students' complaints. The committee must include at least one female, one male, one student, and one faculty. Eight individuals (identified by the letters a to h) have been nominated. The mix of these individuals in the different categories is given as:

Category	Individuals		
Females	<i>a</i> , <i>b</i> , <i>c</i> , <i>d</i>		
Males	<i>e</i> , <i>f</i> , <i>g</i> , <i>h</i>		
Students	<i>b</i> , <i>c</i> , <i>f</i> ,		
Faculty	a, d, e, g, h		

Formulate this problem as an integer linear program.



## 試題六:〈 40 分〉

LP Sensitivity. (Each 8 points, total 40 points)

Consider the following LP problem.

Maximize  $z = 3x_1 + 2x_2 + 5x_3$ 

Subject to

 $x_{1} + 2x_{2} + x_{3} \le 430 \text{ (Operation 1)}$   $3x_{1} + 2x_{3} \le 460 \text{ (Operation 2)}$   $x_{1} + 4x_{2} \le 420 \text{ (Operation 3)}$  $x_{1} \ge 0, x_{2} \ge 0, x_{3} \ge 0$ 

The optimum tableau is:

Basic	$x_1$	$x_2$	$x_3$	$\chi_4$	$x_5$	$x_6$	RHS
Z	4	0	0	1	2	0	1350
$x_2$	-0.25	1	0	0.5	-0.25	0	100
$x_3$	1.5	0	1	0	0.5	0	230
$x_6$	2	0	0	-2	1	1	20

(a) Since operation 3 has the slack capacity of 20 at the optimum solution, if we shift 20 from operation 3 to operation 2, new RHS = \_\_\_\_\_, new solution  $(x_2, x_3, x_6) =$  \_\_\_\_\_. (b) If new objective value *z* becomes to be  $3x_1 + 6x_2 + x_3$ , new cost vector  $C_B =$  \_\_\_\_\_\_, dual variable vector Y = \_\_\_\_\_\_. Is the current solution still optimum? Answer "yes" or "no" and show why (no points will be given without showing the computation). \_\_\_\_\_\_

第3頁〈共3頁〉