KENYA METHODIST UNIVERSITY

END OF FIRST TRIMESTER 2008 EXAMINATIONS

FACULTY   :   SCIENCE AND SOCIAL STUDIES
DEPARTMENT   :   COMPUTER AND INFORMATION SCIENCE
COURSE CODE   :   MATH 331
COURSE TITLE   :   OPERATIONS RESEARCH I
TIME   :   3 HOURS

Instructions:
- *Answer question ONE (compulsory) and any other TWO questions.*

Question 1 (30 marks)

a) State and explain briefly three main basic elements of a Mathematical Model in
    Operations Research.   (3 mks)

b) Define the following:
    (i) A feasible solution.

    (ii) an optimal solution.   (2 mks)

c) Consider the situation of deciding on the number of units to be manufactured of two
    different products. Let the profits per unit of products I and product II be 2 and 5
    respectively. Each unit of product I require 3 machine hours and 9 units of raw
    materials while each unit of product II requires 4 machine hours and 7 units of raw
    materials. The maximum available machine hours and raw material units are 200 and
    300 respectively. A minimum of 20 units is required for product I.
    (i) Form a linear optimization model.   (5 mks)
    (ii) Use graphical method to solve the linear programming model in (i) above.
                                                                  (5 mks)

d) (i) Define a degenerate solution.   (2 mks)

    (ii) What are the possible implications of degeneracy in a linear program? (2 mks)

    (iii) Solve the following linear programme using simplex method.
             Maximise $z = 3x_1 + 9x_2$

        Subject to: $+ 4x_2 \leq 8$
                       $x_1 + 2x_2 \leq 8$ (11 mks)
                       $x_1 \geq 0, \ x_2 \geq 0$

Question 2 (20 mks)
Consider the following linear programme

Minimize $y_0 = 20y_1 + 30y_2 + 50y_3 + 40y_4$

Subject to: $\quad 4y_1 + 6y_2 + y_3 + 2y_4 \geq 12$
$$2y_1 + y_2 + 6y_3 + 5y_4 \geq 4$$
$$y_1 + 2y_2 + 4y_3 + 3y_4 \geq 8$$
$$y_i \geq 0,\ i = 1,2,3,4$$

Use simplex method to find the optimal solution of this primal by solving its dual.

Question 3 (15 marks)

a) Obtain the dual of the following linear programme.

Minimise $x_0 = 50x_1 + 40x_2 + 30x_3$

Subject to: $\quad 3x_1 + 2x_2 + x_3 \geq 10$
$$3x_2 - x_3 \geq 9$$
$$x_1 + 3x_3 \geq 15$$
$$x_1 + x_2 - x_3 \geq 8$$
$$x_2 \geq 0,\ x_3 \geq 0,\ x_1, \quad \text{Is unconstrained in sign}$$

(5 mks)

b) Given the linear program

Minimise $z = 4x_1 + x_2$

Subject to: $\quad 3x_1 + x_2 = 3$
$$4x_1 + 3x_2 \geq 6$$
$$x_1 + 2x_2 \leq 4$$
$$x_1 \geq 0,\ x_2 \geq 0$$

Apply the M-Technique to solve the above linear program. (15 mks)

Question 4 (20 marks)
a) State the three main properties of a general linear programming problem. (3 mks)

b) Apply the cutting plane method to solve the following linear program.

Minimise $z = -3x_1 - 4x_2$

Subject to: $\quad 3x_1 + 2x_2 \leq 8$
$$x_1 + 4x_2 \leq 10$$
$$x_1,\ \text{and integer}$$

(17 mks)