UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022

COURSE NAME	:	LINEAR PROGRAMMING
COURSE CODE	:	BWA 20403
PROGRAMME CODE	:	BWA
EXAMINATION DATE	:	JANUARY/ FEBRUARY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS
		2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK**

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) Fakhry plans to invest RM16,000, RM14,000 and RM17,000 in each month of the next quarter. He has identified four investment opportunities. Investment A requires an investment of RM5,000, RM8,000 and RM2,000 in month 1, 2 and 3, respectively, and has a present value (a time-discounted value) of RM8,000. Investment B requires RM7,000 in month 1 and RM10,000 in month 3, and has a value of RM11,000. Investment C requires RM4,000 in month 2 and RM6,000 in month 3, and has a value of RM6,000. Finally, investment D requires RM3,000, RM4,000 and RM5,000 and has a value of RM4,000. Fakhry aims to maximize the sum of the returns on the project selected. Formulate the problem as an integer linear programming model. Do not solve.

(7 marks)

(b) Describe on how the following situations are recognized in an iteration of the simplex method. Give an example for each situation.

(i) Degeneracy

(3 marks)

(ii) Infeasible solution

(3 marks)

Q2 Consider the following linear programming model

Minimize $z = 2x + 3y$

Subject to

$$\begin{aligned} 4x + 3y &\geq 12 \\ x - y &\geq -3 \\ y &\leq 6 \\ 2x - 3y &\leq 0 \\ x, y &\geq 0. \end{aligned}$$

(a) Solve the above linear programming problem graphically.

(7 marks)

(b) If in general the objective function is written as $z = c_1x_1 + c_2x_2$, determine the range of optimality for c_1, given c_2 remains unchanged.

(3 marks)

(c) Describe on the optimal solution if the objective function is changed to $z = \frac{19}{3}x + 3y$.

(2 marks)

Q3 Solve the following linear programming problem using the Two – Phase method.

Minimize $z = -3x_1 + x_2 - 2x_3$

Subject to

$$x_1 + 3x_2 + x_3 \leq 5$$
$$2x_1 - x_2 + x_3 \geq 2$$
$$4x_1 + 3x_2 - 2x_3 = 5$$
$$x_1, x_2, x_3 \geq 0.$$

(18 marks)

Q4 TechCo manufactures two types of televisions. The only scarce resource that is needed to produce televisions is labour. At present, the company has two labourers. Letting x_i be the number of type i televisions produced each week, the following Linear Programming model is obtained for the TechCo problem. The optimal tableau is given in **Table 1** where the aims is to maximize the profit and the constraints are the total working times of the labourers.

Maximize $z = 3x_1 + 2x_2$ (Profit)

Subject to

$x_1 + 2x_2 \leq 40$ (Labourer 1)

$2x_1 + x_2 \leq 50$ (Labourer 2)

$x_1, x_2 \geq 0$

Table 1: Optimal tableau

Basic	x_1	x_2	s_1	s_2	Solution
z	0	0	1/3	4/3	80
x_1	1	0	-1/3	2/3	20
x_2	0	1	2/3	-1/3	10

a) For what range of values of the profit of a type 1 television would the current solution remain optimal?

(8 marks)

b) If Labourer 2 were willing to work up to 85 hours per week, solve the new problem using information from the optimal table.

(11 marks)

c) A type 3 television is under consideration for production. The specifications of a type 3 television are as follows: profit, RM3 per unit, 2 hours of Labourer 1 per unit, 2 hours of Labourer 2 per unit. Should TechCo manufacture any type 3 televisions? Justify your answer.

(6 marks)

Q5 Consider the following linear programming model

$$\text{Minimize } z = 5x_1 + 2x_2 + 4x_3$$

Subject to

$$\begin{aligned} x_1 + 4x_2 + 2x_3 &\geq 8 \\ 3x_1 + x_2 + 2x_3 &\geq 7 \\ x_1 + x_2 + x_3 &\geq 5 \\ x_1, x_2, x_3 &\geq 0. \end{aligned}$$

Find the optimal solution of the above linear programming model by using the dual simplex method.

(16 marks)

Q6 Consider the following integer linear programming model.

$$\text{Maximize } z = 5x_1 + 8x_2$$

Subject to

$$\begin{aligned} 4x_1 + 7x_2 &\leq 28 \\ 9x_1 + 6x_2 &\leq 30 \\ x_1, x_2 &\geq 0 \text{ and integers.} \end{aligned}$$

Find the optimal integer solution using the branch-and-bound (B&B) method.

(16 marks)

- END OF QUESTIONS -