THE OPEN UNIVERSITY OF SRI LANKA
FACULTY OF MANAGEMENT STUDIES
BACHELOR OF MANAGEMENT STUDIES (HONOURS) DEGREE
PROGRAMME - LEVEL 6
ACADEMIC YEAR: 2023/24
OSU6502 - OPERATION RESEARCH
ASSIGNMENT TEST
DURATION: TWO (02) HOURS

DATE: 18TH FEBRUARY 2024	TIME: 1.30PM – 3.30 PM

Instructions:
Answer **FOUR** questions ONLY.
All questions carry equal marks.
Non-programmable calculators are allowed.
This question paper carries 5 questions in 4 pages.

Question 1

A company manufactures 3 products: Fruit juice, Soft drink, Energy drink. The resource utilization, resource availability and profit per unit of each product are given below:

Product	Resource Requirement			Profit/ unit (Rs.)
	Water (litres)	Time in manufacturing department (hours)	Time in packaging department (hours)	
Fruit juice	10	7	2	12
Soft drink	2	3	4	3
Energy drink	1	2	1	1
Availability of resources per month	100	77	80	

You are required to determine the quantities of fruit juice, soft drink and energy drink, so that the total profit is maximized.

a) Formulate a linear programming model for the above problem. (Use x_1, x_2 and x_3 as number of units of fruit juice, soft drink and energy drink respectively). **(5 marks)**

b) Prepare the first simplex table and find the pivot element, the incoming variable and the outgoing variable. **(3 marks)**

c) The final simplex table for the above problem is given below.

Note: s1, s2, s3 relates to availability of water, time in manufacturing department and time in packaging department respectively.

Cj	Basic Variables	Quantity	12 x1	3 x2	1 x3	0 s1	0 s2	0 s3
12	x1	73/8	1	0	-1/16	3/16	-1/8	0
3	x2	35/8	0	1	13/16	-7/16	5/8	0
0	s3	177/4	0	0	-17/8	11/8	-9/4	1
Zj			12	3	27/16	15/16	3/8	0
Cj -Zj			0	0	- 11/16	- 15/16	-3/8	0

(i) What is the optimal solution? (2 marks)
(ii) Interpret the shadow prices. (3 marks)
(iii) Develop the dual for the problem. (4 marks)
(iv) Find the optimal values for the dual variables. (3 marks)

(v) Find the range within which the profit of Soft drink can be changed without affecting the optimal solution. (5 marks)

(Total 25 marks)

Question 2

Four projects, P_1, P_2, P_3 and P_4 are to be implemented. These projects could be implemented in any of the four locations L_1, L_2, L_3 or L_4. But the labour requirement would depend on the particular project and the location it is assigned, as shown in the table below.

Labour Requirement

	L_1	L_2	L_3	L_4
P_1	12	17	14	15
P_2	7	6	8	9
P_3	21	15	27	20
P_4	15	11	17	18

a) Find the optimal plan of assignment projects to location that would minimize the total labor requirement. (10 marks)

b) Find the optimal plan of assigning project to locations given that project P_2 should not be assigned to location L_3. (10 marks)

c) Explain what is an unbalanced assignment problem and how to solve it? (5 marks)

(Total 25 marks)

Question 3

A company has three factories, A, B and C that turns out tables. The weekly capacities of the factories A, B and C are 5000, 6000 and 2500 units respectively. These tables are transported to four distribution centers P, Q, R and S whose weekly demands are 6000, 4000, 2000 and 1500. The cost of transporting one unit from a given factory to a given distribution center is explained in the table below.

Cost of Installation (Rs. 000)

FACTORY	DISTRIBUTION CENTRE			
	P	Q	R	S
A	3	2	7	6
B	7	5	2	3
C	2	5	4	5

The company wishes to develop the transportation plan that would minimize total cost of transport.

    a) Find an initial feasible solution using least cost method.   (8 marks)

    b) Solve the transportation problem using MODI method.   (17 marks)

(Total 25 marks)

Question 4

A dealer supplies you the following information with regard to a product dealt-in by him:
Annual demand = 10,000 units
Ordering cost = Rs. 1,000 per order
Holding cost = Rs. 400 per month
Price = Rs. 20 per unit
To store the product 10 square feet is required.

a) Calculate the economic order quantity (EOQ) of the product.   (3 marks)

b) Calculate the cost of maintaining the inventory.   (3 marks)

c) Calculate the reorder level of the products if lead time is 5 days.   (3 marks)

d) If the stock out cost is Rs. 10/- per unit per month, calculate the EOQ.   (3 marks)

e) If maximum storage capacity is 200 square feet, calculate the EOQ.   (2 marks)

f) If a discount of 2% is offered for orders greater than 50 units but less than 100 units and 3% discount is offered for orders equal or greater than 100 units, calculate the inventory costs for the following scenarios:

i) Order quantity <=50

ii) 50 < Order quantity < 100

iii) 100 <= Order quantity   (9 marks)

g) Calculate the EOQ if the total budget available to purchase the material is Rs. 10,000/-.

    (2 marks)

(Total: 25 marks)

Question 5

Write short notes on the following with suitable illustrations.

a) Unbalanced Transportation Problem (6 marks)
b) Limitations of Assignment Theory (6 marks)
c) North West Corner Rule Method (6 marks)

d) Comparison of graphical method and simplex method in solving Linear Programming problems

(7 marks)

(Total: 25 marks)

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Formulae

$$EOQ = \sqrt{\frac{2DA}{C}}$$

$$EOQ = \sqrt{\frac{2DA}{C(1 - \frac{D}{R})}}$$

$$K = \frac{DA}{Q} + \frac{QC}{2} - \frac{DRm}{100}$$

$$EOQ = \sqrt{\frac{2DA(C + S)}{CS}}$$