THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. /B.Ed. Degree Programme
APPLIED MATHEMATICS-LEVEL 05
APU3141/APE5141- Linear Programming
Final Examination 2014/2015
Duration: Two Hours

Date: 16.05.2015	**Time: 9.30 a.m- 11.30 a.m**

Answer four questions only

(1) A person requires 10, 12, and 12 units of chemicals *A, B* and *C* respectively for his garden. A liquid product contains 5, 2 and 1 units of *A,B* and *C* respectively per jar. A dry product contains 1, 2 and 4 units of *A, B* and *C* per carton. If the liquid product sells for Rs.3 per jar and the dry product sells for Rs.2 per carton, how many of each should be purchased, in order to minimize the cost and meet the requirements?

(i) Identify and define the decision variables for the problem.

(ii) Define the objective function.

(iii)State the constraints to which the objective function should be optimized.

(iv)Solve the formulated problem using the graphical method.

(2) (a) Illustrate graphically the following cases of solutions in Linear Programming problems:
i) Multiple optimal solutions.
ii) No-feasible solution.
iii) Unbounded solution.

(b) The final simplex tableau for a profit maximization linear programming problem is given below. Here, X_1, X_2 are products, s_1, s_2 and s_3 are the slack in labor hours and raw material and Z is the total profit:

Basis	X_1	X_2	s_1	s_2	s_3	Solution
X_1	1	0	-1	1/3	0	2
X_2	0	1	1	-1/6	0	4
s_3	0	0	4	-2	1	8
Z	4	5	1	1/2	0	28

(i) Is the solution feasible? Justify your answer.

(ii) Is the solution optimal? Justify your answer.

(iii) How many of X_1 and X_2 products are needed to produce according to this solution? What is the total profit?

(3) The captain of a cricket team has to allot five middle batting positions to five batsmen. The average runs scored by each batsman at these positions are as follows:

		Batting position				
		I	*II*	*III*	*IV*	*V*
Batsman	***P***	40	40	35	25	50
	Q	42	30	16	25	27
	R	50	48	40	60	50
	S	20	19	20	18	25
	T	58	60	59	55	53

(i) Find the assignment of batsmen to positions which would give the maximum number of runs.

(ii) If another batsman 'U' with the following average runs in batting positions as given below is added to the team:

Batting position	*I*	*II*	*III*	*IV*	*V*
Average runs	45	52	38	50	49

Should he be included to play in the team? If so, who will be replaced by him?

(4) (i) Briefly explain the role of artificial variables in linear programming.

(ii) What are the artificial variable techniques used in linear programming?

(iii) Use Big-M method to solve the following linear programming problem:

Maximize $z = 2x_1 + x_2 - 3x_3$,

Subject to $x_1 + x_2 + x_3 \geq 6$,

$2x_1 + x_2 = 14$,

$x_1, x_2, x_3 \geq 0$.

(5) A company has received a contract to supply gravel for three new construction projects located in towns *A*, *B* and *C*. Construction engineers have estimated the required amounts of gravel which will be needed at these construction projects as shown below:

Project location	**Weekly requirement (truck loads)**
A	72
B	102
C	41

The company has three gravel plants *X*, *Y* and *Z* located in three different towns. The gravel required by the construction projects can be supplied by these three plants. The amount of gravel which can be supplied by each plant is as follows:

Plant	**Amount available per week (truck loads)**
X	76
Y	62
Z	77

The company has computed the delivery cost from each plant to each project site. These costs (in rupees) are shown in the following table:

Plant \ Cost per truck load	*A*	*B*	*C*
X	4	8	8
Y	16	24	16
Z	8	16	35

(i) Schedule the shipment from each plant to each project in such a manner so as to minimize the total transportation cost within the constraints imposed by plant capacities and project requirements.

(ii) Find the minimum cost.

(6) Consider the following Primal problem:

Maximize $z = -y_1 + 3y_2$,

Subject to $2y_1 + 3y_2 \leq 6$,

$y_1 - 2y_2 \geq -2$,

$y_1 \geq 0, y_2 \geq 0$

(i) Write down the dual problem for the above primal problem.

(ii) Solve the dual problem given in (i) by using the dual simplex method. Hence, write the solution of the primal problem.

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