National University of Computer and Emerging Sciences
Chiniot-Faisalabad Campus

Operations Research

Assignment no. 03

Deadline: 2nd Lecture of the Current week

CLO#02 Analyze the sensitivity of the LPP and computation of Some special type of the LPP.

Question no. 1:(CLO 2) 15 Marks

Cloud Dynamics (software firm) wants to allocate specialized developer capacity from its four global teams (T_1 to T_4) to five valuable client project destinations (D_1 to D_5). The numbers in the center of the given table are the unit cost of deploying one developer-week of Team to a specific Client's Project Destination.
The objective is to minimize the total deployment cost.
The initial basic feasible solution (IBFS) is determined using the Least Cost Method, and the respective allocation quantity ($\mathbf{x_{ij}}$) is placed in parentheses in the cell.

Team / Project	**D_1**	**D_2**	**D_3**	**D_4**	**D_5**	**Supply**
T_1	15	**7** (20)	**8** (25)	20	14	**45**
T_2	10	15	20	**7** (20)	**9** (30)	**50**
T_3	**20** (30)	11	19	12	20	**30**
T_4	25	20	**18** (25)	30	**13** (15)	**40**
Demand	**30**	**20**	**50**	**20**	**45**	**165**

Question no. 2: (CLO 2) 25 Marks

Yadea is producing its flagship electric scooter and must allocate its production capacity to three different battery technologies to maximize its total **Profit (Z)**. The three types of batteries are x_1 (Lithium Iron Phosphate), x_2 (Nickel Manganese Cobalt/ gray lithium), and x_3 (Graphene-Enhanced Lead-Acid).
The following table represents the availability of the resources and their requirements for per battery unit.

Resource	**x_1** ($LiFePO_4$)	**x_2** (NMC)	**x_3**(Graphene)	Availability
R_1= Nickel Stock (kg)	a_{11}= 1	a_{12}= 4	a_{13}= 1	b_1= 300
R_2= Welding Time (hrs)	a_{21}= 2	a_{22}= 3	a_{23}= 1	b_2= 500
R_3= Casing Units	a_{31}= 1	a_{32}= 2	a_{33}= 2	b_3= 450
Profit ($)	c_1= 30	c_2= 60	c_3= 40	

Consider the optimal table for the given problem solved by the simplex method, where x_4, x_5, and x_6 are slack variables of constraints, respectively.

B.V.	**x_1**	**x_2**	**x_3**	**x_4**	**x_5**	**x_6**	**Solution (b_i)**
Z	0	40	0	20	0	10	10500
x_1	1	6	0	2	0	-1	150
x_5	0	-7	0	-3	1	1	50
x_3	0	-2	1	-1	0	1	150

(a) Compute the rate of change in the optimal solution, if a unit increase or decrease occurs in the availability of the Nickel stock (R_1), and its feasibility range.

(b) Explain why the optimal solution is not producing x_2? On the other hand, the market survey suggested the manufacturing of the gray Lithium battery (x_2). Decide the minimum value of the coefficient c_2, such that the optimal solution should produce x_2.

(c) A new Quality Control (QC) procedure has been implemented to ensure battery performance. This procedure utilizes a centralized inspection facility with a total capacity of 650 hours, with consumption rates of 1, 2, and 2 hours for one unit of x_1, x_2, and x_3, respectively. Now, compute the optimal solution after the addition of this procedure (new constraint).

(d) Due to market demand, the company wants to add a new battery, Lithium Sulphur (x_s), that yields a profit of \$75 per unit. Producing one unit of this battery requires $2, 5$, and 3 units of Resource R_1, R_2, and R_3, respectively. Determine the optimal solution after the addition of this battery to the product line-up.

(e) Consider the changes $a_{12} = 2$, $b_3 = 400$, and $c_3 = 25$, then recompute the table by using c_b and B^{-1} of the current optimal solution and discuss the feasibility or optimality of the recomputed table.

Best of luck