Addis Ababa Institute of Technology
Addis Ababa University
CENG 6103 System Analysis and Management Techniques I
Assignment II

1. A concrete manufacturer is concerned about how many units of two types of concrete elements to produce during the next time period to maximize profit. Each element of type "A" generates a profit of ETB 60, while each element of type "B" produces a profit of ETB 40. Two and three units of raw materials are needed to produce one concrete element of type A and B, respectively. Also, four and two units of time are required to produce one concrete element of type A and B respectively. If 100 units of raw materials and 120 units of time are available, formulate a linear programming model for this problem to determine how many units of each type of concrete elements should be produced to maximize profit.
(Formulate the LP model and use Graphical method to solve the problem and check your results using LINDO)

2. A contractor may purchase material from two different sand and gravel pits. The unit cost of material including delivery from pits 1 and 2 is ETB 50 and ETB 70 per cubic meter, respectively. The contractor requires at least 100 cubic meter of mix. The mix must contain a minimum of 30% sand. Pit 1 contains 25% and pit 2 contains 50% sand. If the objective is to minimize the cost of material, define the decision variables and formulate a mathematical model.
   - Draw the feasible region
   - Determine the optimum solution by the graphical method
   - Use Excel-SOLVER to model and solve this problem

3. Use the simplex method to solve the problem:

$$
\begin{aligned}
\text{Maximize} \quad & z = x_1 + 2x_2 + 3x_3 \\
\text{Subject to} \quad & 2x_1 + x_2 + x_3 \leq 4 \\
& x_1 + 2x_2 + x_3 \leq 4 \\
& x_1 + x_2 + 2x_3 \leq 4 \\
& x_1 + x_2 + x_3 \leq 3 \\
& x_1 \geq 0;\ x_2 \geq 0;\ x_3 \geq 0
\end{aligned}
$$

a. Determine the basic feasible initial solution .
b. Define the basic and non-basic variables.
c. Determine the maximum value of z and the optimum values of x1,x2,x3 using the primal simplex.
d. Formulate the dual problem and solve it using the dual simplex.
e. Solve the problem using Lindo program

4. A company manufactures three different types of pipe fittings: tees, elbows, and splicers. Daily production of these parts are limited by the availability of lathe time, grinder time and labor as shown below.

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Resources	Products			Availability of Resources
	100 tees	100 elbows	100 splicers	
Person hours	6	4	5	24
Lathe hours	1	2	1	8
Grinder hours	2	1	0	12
Profit per 100 units	700	550	480	

a. Formulate a linear program that will suggest a production policy for maximizing daily profit.
b. Set the augmented form by adding the appropriate slack and surplus variables.
c. Solve for the optimal solution using the simplex method
d. Use LIndo to solve the LP problem
e. What is constraining the present production level?

5. A Contractor is organizing the supply of ready-mix concrete to four sites. He estimates that the total daily requirements of the four sites amount to twenty four lorry loads and he finds three suppliers who are able to meet this demand between them. The separate amounts available from the suppliers are (in lorry loads) are shown below: S1: 4; S2: 8; S3:12 and the quantities needed for the four sites are A: 5 , B: 2, C:10, D:7

In the price negotiation it was agreed that transport costs will be charged to the contractor in proportion to mileage incurred. The distances involved are:

	A	**B**	**C**	**D**
S1	6	12	2	5
S2	18	21	13	12
S3	11	16	5	6

It is required for the contractor to determine the minimum total distance to be traveled and corresponding supply arrangement from each supplier to each site. Solve the transportation problem using NWC method and SS and verify results using TORA

6. Five managers who differ in ability and experience are to be placed in charge of five projects which are different in type and value. The suitability of each manager for each project is assessed on a numerical scale with a maximum of twenty points. The results are shown below:

	1	**2**	**3**	**4**	**5**
A	18	16	11	19	5
B	14	10	15	8	6
C	9	13	8	8	6
D	15	14	10	12	10
E	11	11	14	10	8

To which project should each manager be assigned in order to obtain the highest total points score for the firm? Solve the assignment problem using the Hungarian Method and verify results using TORA.

(Note: The problem here is to maximize output that is to allocate construction managers such that the overall output for the all construction projects is the best possible. This can be converted to a minimization problem by considering the points below the maximum that each construction manager's suitability was assessed for each construction project.)