Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Computer Science and Technology
300 Level 1st Semester Examination –Jul./Aug. 2016
IIT 372-2 Operation Research

Instructions to candidates
Duration: Two(02) hours
Number of questions: Four(04) Essay Questions
Mark allocation: 100 mark
Use standard symbols without definition.
Scientific calculators are allowed.
Answer all questions

1.

a. The Rayon Company wishes to introduce a new brand of computers, the *Deluxe* and the *Special*. The profit on the *Deluxe* brand is Rs. 12,000 per unit and the *Special's* profit is Rs. 10,000. Each brand goes through two phases in production process, and there are only 100 hours available daily at the construction stage and only 80 hours available at the finishing and inspection stage. Each *Deluxe* brand requires 20 minutes of construction time and 10 minutes of finishing and inspection time. Each *Special* brand requires 15 minutes of construction time and 15 minutes of finishing and inspection time.
Management wants to determine how many units of each product to produce as to maximize profit.

i. Formulate a linear programming model for this problem. (05 mark)
ii. Use the **graphical method** to solve this model. (06 mark)
iii. How many units of each product should be manufactured to maximize profit? (02 mark)

b. Solve the following linear programming problem using **simplex method**. (12 mark)

$$\text{Maximize } z = 3x + 4y + 5z$$

$$\begin{aligned} \text{subject to } & 2x + 4y + 3z \le 80 \\ & 4x + 2y + z \le 48 \\ & x + y + 2z \le 40 \\ & x, y, z \ge 0 \end{aligned}$$

2. The Extreme Logistics Company supplies its four retail outlets from its four plants. The shipping cost per shipment from each plant to each retail outlet is given below. Plants 1, 2, 3, and 4 make 14, 10, 15, and 13 shipments per month, respectively. Retail outlets A, B, C, and D need to receive 10, 15, 12, and 15 shipments per month, respectively.
The distribution manager, now wants to determine the best plan for how many shipments to send from each plant to the respective retail outlets in each month. Manager's objective is to minimize the total shipping cost.

Retail Outlet / Plant	Unit Shipping Cost (in $ '00)			
	A	B	C	D
1	10	30	25	15
2	20	15	20	10
3	10	30	20	20
4	30	40	35	45

a. Formulate this as a balanced transportation problem. (06 mark)
b. Use the **north-west corner rule** or **minimum cost method** to obtain an initial basic feasible solution for the problem as formulated in part (a). (07 mark)
c. Starting with the initial basic feasible solution from part (b), interactively apply the **transportation simplex method** to obtain an optimal solution. (12 mark)

3. The coach of a swimming team needs to assign swimmers to a 200-yard medley relay team to send to the *Rio Olympics 2016*. Since most of his best swimmers are very fast in more than one stroke, it is not clear which swimmer should be assigned to each of the four strokes. The four fastest swimmers and the best times (in seconds) they have achieved in each of the strokes (50 yards) are shown in the following table.

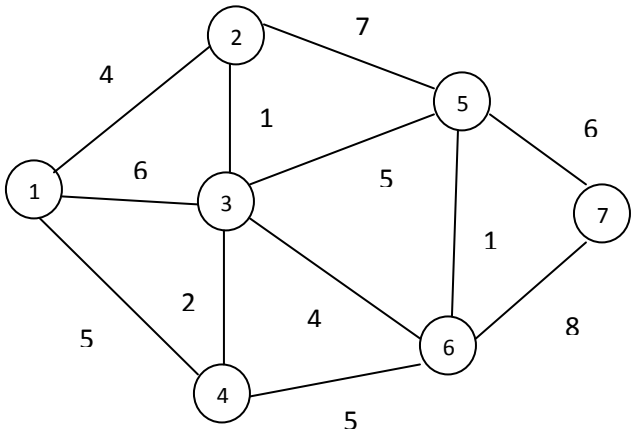
Swimmer / Stroke	Mathews	Raheem	Chandu	Deshan
Backstroke	15	17	24	16
Breaststroke	10	15	12	13
Butterfly	17	19	18	16
Freestyle	13	20	16	14

The coach wishes to determine how to assign four swimmers to four different strokes to minimize the sum of the corresponding best times.

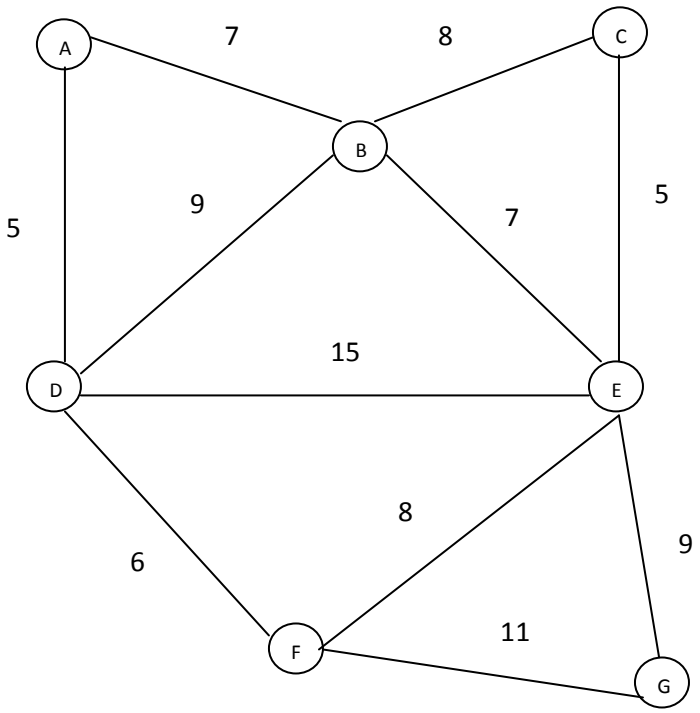
a. Formulate this problem as an assignment problem. (05 mark)
b. Determine the optimal assignment using **Hungarian algorithm**. (15 mark)

4.

a. Use **Dijkstra's algorithm** to find the shortest path from node 1 to node 7 of the following network, where numbers represent actual distances between the corresponding nodes. (10 mark)



b. Use **Prim's algorithm** or **Kruskal's algorithm** to find a "*minimum spaning tree*" of the following network. (10 mark)



c.

i. State the **maximum flow – minimum cut theorem**. (02 mark)

ii. Verify, the above theorem by using the following network. (08 mark)