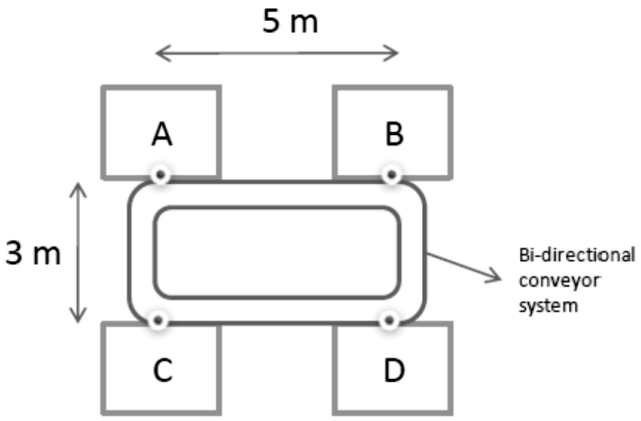
Northern Borders University Faculty of Engineering IE Department	IE 453 Facilities Planning Final Exam Dr. Mohamed Mostafa Date: 18/7/1434 Time Allowed: 2 Hrs

Solve the following Problems

Problem # 1 (15 Points)

Given the following data try to improve the layout using pair-wise exchange method.

Flow between	A	B	C	D
A	.	15	90	70
B		.	75	65
C			.	85
D				.



Problem # (10 Points)

A toy manufacturing company makes ten different types of product. There are fifteen equal sized departments involved. Given the following product routings and production forecasts

Construct a from-to chart for the facility

Product	Processing Sequence	Weekly Production
1	A B C D B E F C D H	500
2	M G N O N O	350
3	H L H K	150
4	C F E D H	200
5	N O N	100
6	I J H K L	150
7	G N O	200
8	A C F B E D H D	440
9	G M N	280
10	I H J	250

Problem # 3 (15 Points)

An entrepreneur plans to open a large scale greenhouse to sell the harvest both in domestic and foreign markets. So he made a detailed study to select the best possible location. During the research he learned that the climate of the region has a fatal importance for greenhouses. Then he computed the basic cost items and records the corresponding cost amounts for each site. When he analyzed his budget and the cost amounts he realized that he must select a site which belongs to a tax incentive region. Finally he made a grading for some properties which motivates choosing the site depending on his own intuitive. But he trusts in his computations two times more than his intuitives. The results of his study is illustrated in the table. According to the table, select the best alternative to locate the greenhouse. (Labor cost and energy cost is given annually)

SITE	**Energy Cost**	**Installation cost**	**Labor Cost**	**Ease of transportation** **Weight (0.3)**	**Marketing Opportunity** Weight (0.7)	**Tax incentive**	**Climate conditions**
A	80	500	200	0,8	0,5	1	1
B	70	460	220	0,7	0,9	1	0
C	100	660	180	0,3	0,7	1	1
D	60	600	250	0,9	0,6	0	1
E	90	600	170	0,9	0,4	1	1

يخطط رجل أعمال لفتح صوبة زراعية على نطاق واسع لبيع المحصول في كل من الأسواق المحلية والأجنبية . لذا فإنه قدم دراسة مفصلة لاختيار أفضل موقع ممكن . خلال البحث تعلم أن المناخ في المنطقة له أهمية كبيرة **جدا** للصوبات الزراعية .ثم حسب تكلفة البنود الأساسية وسجل مبالغ التكلفة المقابلة لكل الموقع . وهو يحلل ميزانيته ومبالغ التكلفة أدرك أنه **يجب** تحديد الموقع الذي يتبع منطقة حافز ضريبي . أخيرا قدم تصنيف لبعض الخصائص التي تحفز اختيار الموقع اعتمادا على بديهيتة .لكنه يثق في حساباته **مرتين أكثر** من حدسه. نتائج دراسته موضحة في الجدول . وفقا للجدول، اختر البديل الأفضل لتحديد موقع الصوبة الزراعية (تعطى تكلفة العمالة وتكلفة الطاقة سنويا)

وفقكم الله

Useful Formulas in Location Analysis

For m candidate locations, p critical, q objective, and r subjective factors:

$$CFM_i = CF_{i1} \bullet CF_{i2} \ldots CF_{ip} \qquad i = 1,2,\ldots,m$$

$$OFM_i = \frac{\max\limits_i \left[\sum\limits_{j=1}^{q} OF_{ij}\right] - \sum\limits_{j=1}^{q} OF_{ij}}{\max\limits_i \left[\sum\limits_{j=1}^{q} OF_{ij}\right] - \min\limits_i \left[\sum\limits_{j=1}^{q} OF_{ij}\right]} \qquad i = 1,2,\ldots,m$$

$$OFM_i = \left[\left(\sum_{j=1}^{q} OF_{ij}\right) * \sum_{i=1}^{m} \frac{1}{\sum\limits_{j=1}^{q} OF_{ij}}\right]^{-1} \qquad i = 1,2,\ldots,m$$

$$SFM_i = \sum_{j=1}^{q} w_j SF_{ij} \qquad i = 1,2,\ldots,m$$

$$LM_i = CFM[\alpha\, OFM_i + (1-\alpha) SFM_i]$$

For m existing facilities with rectilinear distances:

$$\min \sum_{i=1}^{m} w_i \left(|x - a_i| + |y - b_i|\right)$$

List in non - decreasing order of $x-coordinates$

$$\sum_{i=1}^{j-1} w_i < \sum_{i=1}^{m} \frac{w_i}{2} \quad and \quad \sum_{i=1}^{j} w_i \geq \sum_{i=1}^{m} \frac{w_i}{2}$$

$j^{th} - x\ coordinate$

List in non - decreasing order of $y-coordinates$

$$\sum_{i=1}^{k-1} w_i < \sum_{i=1}^{m} \frac{w_i}{2} \quad and \quad \sum_{i=1}^{k} w_i \geq \sum_{i=1}^{m} \frac{w_i}{2}$$

$k^{th} - y\ coordinate$

For m existing facilities with squared Euclidean distances:

$$\left(x^*, y^*\right) = \left(\frac{\sum\limits_{i=1}^{m} w_i * a_i}{\sum\limits_{i=1}^{m} w_i}, \frac{\sum\limits_{i=1}^{m} w_i * b_i}{\sum\limits_{i=1}^{m} w_i}\right)$$

For m existing facilities with Euclidean distances:

$$x^{k+1} = \frac{\sum\limits_{i=1}^{m} \frac{w_i * a_i}{\sqrt{\left(x^k - a_i\right)^2 + \left(y^k - b_i\right)^2}}}{\sum\limits_{i=1}^{m} \frac{w_i}{\sqrt{\left(x^k - a_i\right)^2 + \left(y^k - b_i\right)^2}}}$$

$$y^{k+1} = \frac{\sum\limits_{i=1}^{m} \frac{w_i * b_i}{\sqrt{\left(x^k - a_i\right)^2 + \left(y^k - b_i\right)^2}}}{\sum\limits_{i=1}^{m} \frac{w_i}{\sqrt{\left(x^k - a_i\right)^2 + \left(y^k - b_i\right)^2}}}$$

The ABC Cooling and Heating Company manufactures several different types of air conditioners. Five departments are involved in the processing required for the products. A summary of the processing sequences required for the five major products and the weekly production volumes for the products are shown in the tables below along with the department area. Based on the graph-based construction method, develop a block layout.

Product	Process Sequence	Weekly Production
1	ABC	150
2	ABED	200
3	ACE	50
4	ACBE	200
5	ADE	250

Department	Area (ft^2)
A	1500
B	1500
C	1000
D	2000
E	2000