Exam test – Operation Research

1. **(4 points)** Formulate a mathematical model of the following economical problem. Explain what the variables means.

   Mrs. Vokurkova works at the canteen of the Tomato comp. The company has 99 employees, twice as many women as men. Mrs. Vokurkova has a budget 3000 CzK for the next year. She plans to buy salami, cheese, bear and bread. She knows that the biggest profit she has from bear (she purchases one bottle for 10 CzK and sells for 20 CzK). On the other hand she knows that she sell maximally so many bottles as is the number of men in the company. 10 dg of cheese she purchases for 10 CzK and sells for 15 CzK; 10 dg of salami purchases for 7 CzK and sells for 11 CzK. A loaf of bread she purchases for 20 CzK and sells for 30 CzK. She also knows that she needs at least one kilo of cheese or salami per each loaf of bread. Surely, Mrs. Vokurkova wants to maximize her profit, how would she do it?

2. **(4 points)** Solve the following problem in graphical way. Highlight the set of feasible solutions and all optimal solutions.

$$\begin{aligned} & \min 2x_1 + x_2 \\ \text{za } & 2x_1 + 2x_2 \leq 20, \\ & 2x_1 + x_2 \geq 12, \\ & 2x_2 - x_1 \geq 0, \\ & x_1,\ x_2 \geq 0. \end{aligned}$$

3. **(3 + 3 points)** Use the CPM to identify the Critical path of the project, find the shortest possible duration of the project.

Activity	predecessors	duration	number of workers
a	—	3	1
b	—	5	6
c	b	3	6
d	a	4	2
e	d	3	4
f	a, c	1	3

4. **(2 points)** What is the main difference between input- and output-oriented DEA models?

5. **(4 points)** We need to tile our bathroom, so we have asked several companies for their offers. We have obtained following ones.

Company	**CzK per hour of work**	**CzK per m^2 of tiles**	**Ordering time**
D1	150 CzK	700 CzK	14 days
D2	200 CzK	600 CzK	1 week
D3	270 CzK	400 CzK	1 month
D4	220 CzK	500 CzK	5 weeks
D5	200 CzK	500 CzK	1 month

Is there a company that we certainly will not choose?(Explain.)

Is there a company that will be choosen by avery "good"method of multi-attribute decision making? (Explain.)

Write down the ideal and basal alternative.

Find the compromise alternative by ranking method.