Exam test – Operation Research

1. **(4 points)** Formulate the linear optimization model for the following problem. Explain the meaning of variables.

   Mrs. Vokurka works in a canteen of Rajče et al. Company. This company employs 64 employees, while women are about ten more than men. Now, there is a bad situation in the company, hence the employees ask very often Mrs. Vokurka to lend them some money – men for bear, women for bread. Mrs. Vokurka is kind-hearted, so she would like to help them. Unfortunately, she can lend them only the money from the cashbox, maximally 2000 CzK. She wants to lend at least 500 CzK for men and the same amount a least for women. From the previous experiences she knows that the rate of return on the beer loan is 80% and the rate of return on the bread loan is 99%. On the other hand, men (if they come return the loan) give her 10% extra, women (if they come return the loan) give her only 1% extra. Let us suppose that Mrs. Vokurka wants to minimize her lost. Write down a model of such problem.

2. **(4 + 4 points)** Use the graphical solution to solve the following problem, highlight the set of feasible solutions, the optimum. Then solve this problem by using SW. The sensitive analysis upload to the Moodle.

$$
\begin{aligned}
\min 1,5x_1 + x_2 & \\
\text{s. t. } 2x_1 + 2x_2 &\leq 4, \\
6x_1 + 4x_2 &\geq 3, \\
4x_2 - 2x_1 &\geq 0, \\
x_1,\ x_2 &\geq 0.
\end{aligned}
$$

3. **(3 + 3 points)** Draw the precedence diagram for the following problem, apply Critical Path Method to compute the duration of the project. Then use Gannt diagram and decide how many workers at least you need to finish the project in time.

activity	prec.	duration	number of workers
a	—	3	1
b	—	5	6
c	a,b	3	6
d	a	4	2
e	b	3	4
f	d	1	3

4. **(2 points)** Let us suppose a linear optimization problem with a profit type objective function, two variables and two constrains. In the second step of Simplex method we obtain the following table.

	x_1	x_2	d_1	d_2	b
x_2	2	1	0	3	15
d_1	2	0	1	3	5
z	2	0	0	3	150

Write down the basic solution form this step. Is this solution fasible? Is it optimal? Explain your answers.

From the table, it is possible to determine at least one coefficient from the objective function. Which one and what is the value?