**Laboratory "Modeling and Simulation of Dynamic Systems"**
Institute of the Theory of Electrical Engineering, Measurement and Information Systems, WUT

Exercise No 6B

**MODELING OF DISTRIBUTION OF EPIDEMY**

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# 1 The aim of experiments

Learning the phenomena of spreading the epidemy in a big population.

# 2 Dynamic model of epidemy

We assume two classes of individuals: the healthy set denoted by $x_1$ and set of ill individuals $x_2$. All healthy individuals are susceptible for infection, while the ill individuals either die or recover and after recovering they become resistive to the illness.
We assume the dynamic model of spreading the epidemy in the form

$$\frac{dx_1}{dt} = -bx_1x_2 \tag{1}$$

$$\frac{dx_2}{dt} = bx_2(x_1 - a/b) \tag{2}$$

The Simulink model corresponding to these equations is given in Fig. 1 (file **epidemia.mdl**).

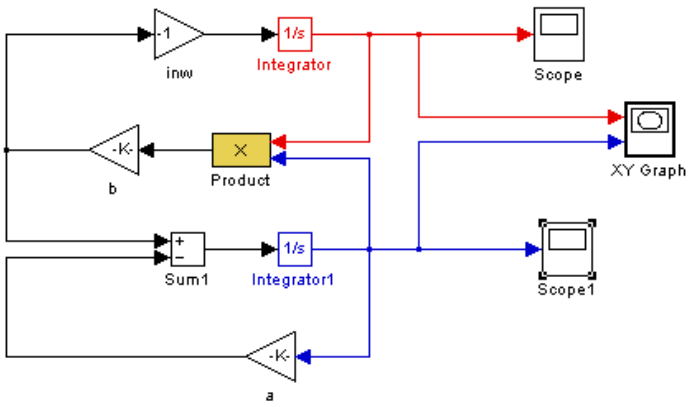


Figure 1: *The Simulink model of spreading the epidemy*

# 3 Program of numerical experiments

In the numerical experiments assume the parameters $a = 0.08$, $b = 0.00002$.

1. Simulate the changes of $x_1(t)$ and $x_2(t)$ at different initial conditions, for example $x_2(0) = 10$, 100, 1000, 2000. The initial condition for $x_1(0)$ results from the value of $x_2(0)$ (we assume that the initial population of $x_1(0) + x_2(0) = 10000$)

2. In each experiment observe the changes of $x_1(t)$ and $x_2(t)$ on the phase plane, where the phenomena are described by the equation

$$\frac{dx_2}{dx_1} = -\frac{x_1 - a/b}{x_1} \tag{3}$$

3. Check how the value of parameter $b$ (responsible for the frequency of contacting two groups of individuals) influences the dynamic changes of $x_1(t)$ and $x_2(t)$.