Elektrijada 2005.

Problems for the competition in area of
CONTROL SYSTEMS

1.

Impulse response of the continuous system is given: $h(t) = 2e^{-t} - 2e^{-2t}$.

a) Find the discrete transfer function of the system obtained by the discretization of the given continuous system with the impulse invariance method. Sampling period is T = ln2 sec;

b) Continuous system is given the input signal $u(t) = \begin{cases} e^{-t}, t \geq 0 \\ 0, t < 0 \end{cases}$, and the discrete system has the samples of the continuous signal on input: $u(kT) = \begin{cases} e^{-kT}, k \geq 0 \\ 0, k < 0 \end{cases}$, T = ln2 sec. Find the response of both systems and the sampling time kT when the difference of the two systems' responses is the bigest.

2.

System is described by the differential equation $\frac{d^2y}{dt^2} - 3\frac{dy}{dt} + 2y = a\frac{du}{dt} + u$, where is: u – the system input, y – system output and a is the real constant.

a) Obtain the state space model of the minimal order for this system, $\dot{\mathbf{x}}(t) = \mathbf{A}\mathbf{x}(t) + \mathbf{B}u(t);\ y(t) = \mathbf{C}x(t)$, and check its controllability, depending on parameter a;

b) Adopt a=0, find the fundamental matrix $\Phi(t)$ for the previously obtained model and find the control which will bring the system from the initial state $\mathbf{x_0} = [0 \quad 0]^T$ to the state $\mathbf{x}_1 = [1 \quad 2]^T$.

3.

For the closed loop system which open loop function is given by $W(s) = K\frac{1 - Ts}{(1+Ts)(T_1^2 s^2 + 1)}$, T>0, T_1 >0:

a) using the Nyquist criterion, find values of the gain K which stabilize the system;

b) Find values of the gain K which make the closed loop dominant time constant **less** than 1sec.