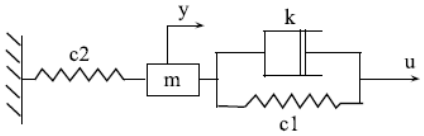
MATLAB és Simulink - Consulation	
Perform the following excersise in MATLAB and Simulink environments! Store the files in a special folder created for this purpose! The name of the folder shall be *Firstname_Lastname_zhm_Matlab01*.	
1	Create Matlab functions constructing the follwing special matrices! The output argument of the functions shall be the constructed matrix!
1.1 *(3)*	Construct an $(n \times n)$ matrix, whose diagonal contains the $1!, 2!, ..., n!$ factorial values and the other elements are set to 0. The input argument of the function is the n size.
1.2 *(3)*	Construct an $(n \times n)$ matrix, whose every a_{ij} elements are 1, if i and j are both even or odd (checkerboard matrix). The input argument of the function is the n size.
2	Create MATLAB functions to perform the following simple calculations.
2.1 *(4)*	The input argument of the function is a matrix. The function computes the average of the matrix elements. The output of the function is the ratio of the number of elements greater than the average and the total number of elements.
2.2 *(4)*	The function estimates the $sin(x)$ value by the n-degree Taylor polynomial of $sin(x)$ around 0, where x and n are the input arguments of the function. $$\sin(x) \approx \sum_{i=0}^{n} \frac{(-1)^i}{(2i+1)!} x^{2i+1} \quad (1)$$
3 *(5)*	Determine numerically the minimum (place and value) of the following function (Booth function) by MATLAB. Visualize the bivariate function over interval $-10 \leq x, y \leq 10$ and the visualize the determined minimum on the same figure. (The exact solution: $f(1,3) = 0$) $$z = (x + 2y - 7)^2 + (2x + y - 5)^2 \quad (2)$$
4 *(5)*	Solve numerically the equation of motion of the following dynamic system with zero initial condition ($y(t)$ function in question) over $t \in [0, 25]$s time interval! The u shall be a ramp function hanem that reaches 1 final value at $t = 0.1$s. The solution shall be performed based on either of the MATLAB `ode` solver. The model parameters: $m = 20$kg, $c_1 = 2$N/m, $c_2 = 3$N/m, $k = 24$Ns/m.  $$m\ddot{y} = c_1(u - y) + k(\dot{u} - \dot{y}) - c_2 y \quad (3)$$
5 *(6)*	Create the system model of the following BLDC motor in Simulink environment, and simulate the rotation of the motor over $t \in [0; 10]$s time interval! The inputs of the model are 5V step voltage at $t = 1$s and 0.05Nm step torque at $t = 5$s. The following equations describe the model of the motor: $$\begin{bmatrix} \dot{i} \\ \dot{\omega} \end{bmatrix} = \begin{bmatrix} -\frac{R}{L} & -\frac{k_i}{L} \\ \frac{k_m}{J} & -\frac{k_s}{J} \end{bmatrix} \begin{bmatrix} i \\ \omega \end{bmatrix} + \begin{bmatrix} \frac{1}{L} & 0 \\ 0 & -\frac{1}{J} \end{bmatrix} \begin{bmatrix} U \\ M \end{bmatrix}, \quad (4)$$ where the state of the system consists of the armature current i, and rotating speed ω, the inputs are the U voltage, and M torque loaded. The parameters: aramature resistance $R = 1.8\Omega$, armature inductivity $L = 2.6 \cdot 10^{-3}$H, motor constants $k_m = 0.035\text{N} \cdot \text{m/A}$, $k_i = 0.03497\text{V} \cdot \text{s/rad}$, rotational inertia $J = 2.4 \cdot 10^{-6}\text{kg} \cdot \text{m}^2$, friction coefficient $k_s = 1 \cdot 10^{-6}\text{kg} \cdot \text{m}^2/\text{s}$.