Programming in Matlab

Project 1.

Write the m-file in Matlab code performing the following tasks:

a. Generate the sinusoidal signal y(*t*) with chosen frequency and amplitude, where *t* is time
b. Generate random signal e(*t*) (white noise) with normal distribution and standard deviation equal to 5% of amplitude of signal y(*t*)
c. Add the generated signals: x(*t*)= y(*t*)+ e(*t*)
d. Select the appropriate filter and perform filtering process on signal x(*t*) to obtain signal y(t)

Tips: use the following functions: ***randn, butter, filtfilt***

Maximum grade: 5

Project 2

Write the m-file in Matlab code performing the following tasks:

a. Import the data from attached files: Ms_p1.mat; Ms_p2.mat; Ms_p3.mat, frequency sampling of data is fs=4000 Hz
b. Plot the signals in one figure but in separated plots
c. Perform the filtering of the signals
d. Calculate the amplitudes of signals

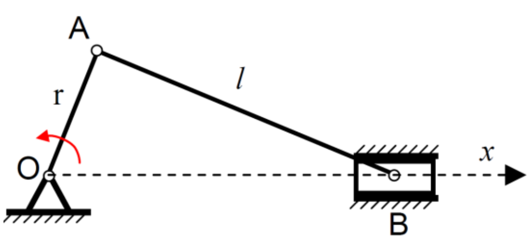
Tips: use the following functions: ***load, butter, filtfilt***

Maximum grade: 5

Project 3

Point B in the mechanical system (fig) moves according to the following equation:

$$x(t) = r\cos(t) + l\sqrt{1-\left(\frac{r}{l}\sin(t)\right)^2}$$



Write the script to animate the movement of the mechanical system

Maximum grade: 5

Project 4

1. Generate sinusoidal signal *y*(*t*) with selected amplitude *A* and frequency *f* (*t*- is time).

2. Generate random signal *e*(*t*) with normal distribution with standard deviation equal to 10% of amplitude *A*.

3. Perform the following process: *x*(*t*)=y(*t*)+*e*(*t*)

4. Plot the autocorrelation function of signals *y* i *x*.

Tips: use the following functions: ***randn, xcorr***

Maximum grade: 4

Project 5

Failure probability of structural component before *N* number of cycles has the following distribution

$$P_f = 1 - e^{-\left(\frac{N}{N_m(\sigma_a)}\right)^{f(\sigma_a)}}$$

Where:

$$N_m(\sigma_a) = \begin{cases} N_\sigma \left(\frac{\sigma_{af}}{\sigma_a}\right)^m & \text{for} \quad \sigma_a \geq \sigma_{af} \\ \infty & \text{for} \quad \sigma_a < \sigma_{af} \end{cases}, \qquad f(\sigma_a) = \frac{p}{N_m(\sigma_a)}$$

and *m* = 8.2; $\sigma_{af} = 204$ MPa; $N_\sigma = 1.4e6$ cycles; *p*=400;

Plot the distribution function $P_f(N, \sigma_a)$ as the three-dimenional function over the $\sigma_a \in \langle 1e2, 5e2 \rangle$ MPa and $N \in \langle 1e2, 1e8 \rangle$ cycles

Tips: use the following functions: ***surf, meshgrid***

Maximum grade: 4

Project 6

1. Load the data from file St3S.xls (only the first sheet). First row represents amplitudes of stress σ_a in MPa, next rows represents the number of cycles to failure N for each stress amplitude (three numbers of cycles to failure for one stress amplitude).

2. Calculate the liner regression coefficients assuming the following variables:

Y=log(N), X=log(σ_a).

3. Plot the loaded point X-Y and the obtained regression line in double logarithmic scale.

Tips: use the following functions: ***xlsread, polyfit, loglog***

Maximum grade: 4

Project 7

Plot the following three-dimensional function

$$z = \sin(e^{x^2 + y^2})$$

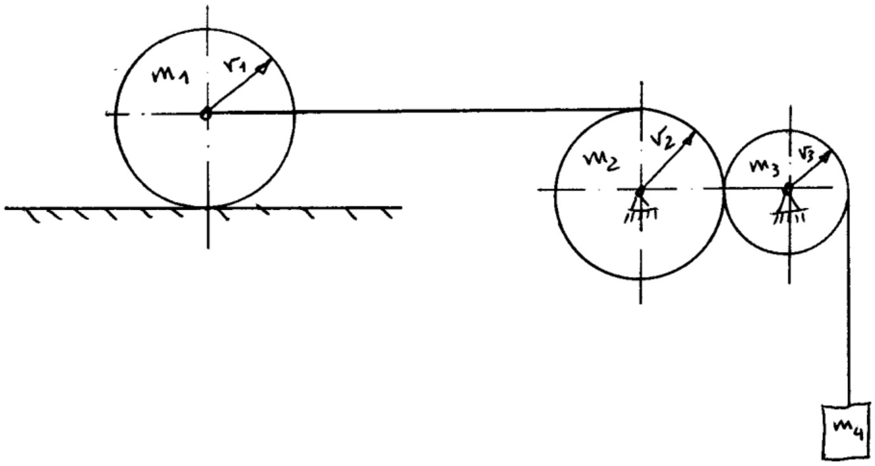
Within the following ranges: $-1.5 \leq x \leq 1.5$, $-1.5 \leq y \leq 1.5$

Tips: use the following functions: ***meshgrid, mesh, surf***

Maximum grade: 3

Project 8

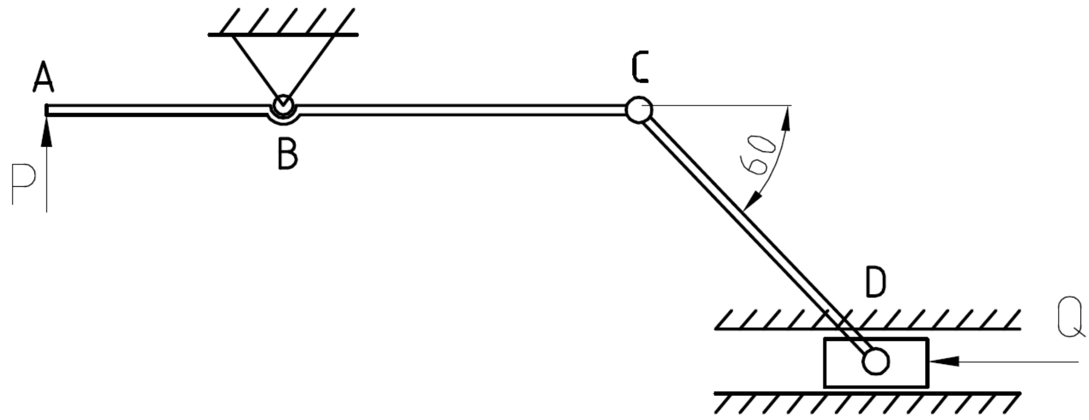
By applying the Lagrange equation determine the acceleration of body 4. Assume: no sliding, non-stretchable cords and homogeneous wheels.
Data: m_1, m_2, m_3, m_4, r_1, r_2, r_3



- Plot the mechanical system in Matlab
- Write Lagrangian's equation and final equations for kinetic and potential energies in the same figure using latex interpreter
- Write the final equation for acceleration of body 4 in the same figure using latex interpreter

Project 9

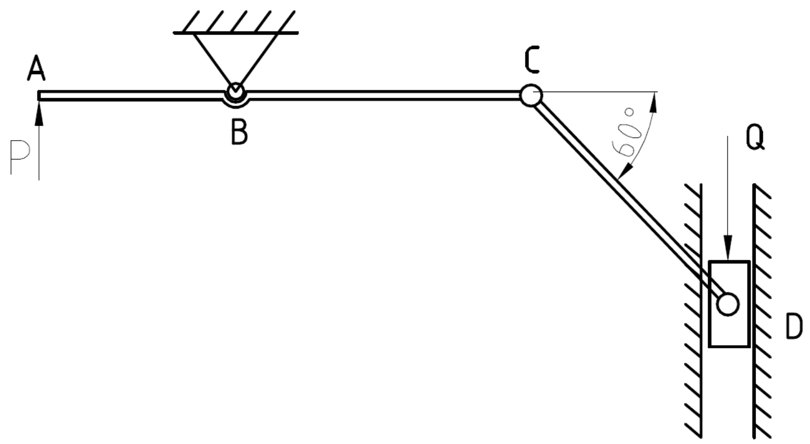
For the given mechanical system calculate force Q to keep the system in static equilibrium. The principle of virtual work must be applied.
Data: P = 12 kN, AB = 0,5BC = 0,1CD=0,10 m



- Plot the mechanical system in Matlab
- Write the equation for principal virtual work in the same figure using latex interpreter
- Write the kinematic relations in the same figure using latex interpreter
- Write the final equation for force Q in the same figure using latex interpreter

Project 10

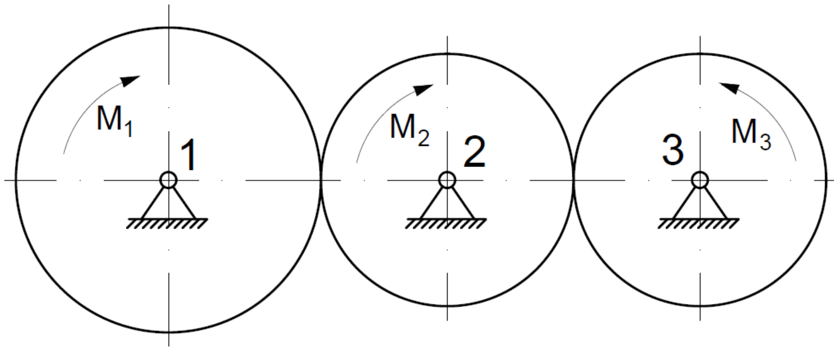
For the given mechanical system calculate force Q to keep the system in static equilibrium. The principle of virtual work must be applied.
Dane: P = 16 kN, AB = 0,5BC = 0,1CD=0,10 m



- Plot the mechanical system in Matlab
- Write the equation for principal virtual work in the same figure using latex interpreter
- Write the kinematic relations in the same figure using latex interpreter
- Write the final equation for force Q in the same figure using latex interpreter

Project 11

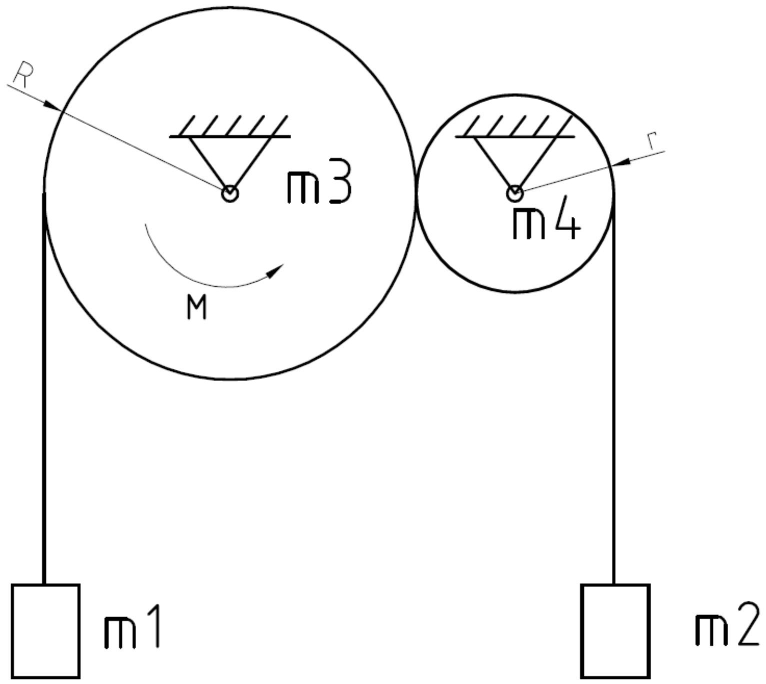
For the given force moments M_1, M_2 and M_3 applied to wheels with mases m_1, m_2 and m_3 and radius r_1, r_2 and r_3, respectively - determine the angular acceleration of body 1. Assume: no sliding and homogeneous wheels.



- Plot the mechanical system in Matlab
- Write Lagrangian's equation and final equation for kinetic energy and generalized force in the same figure using latex interpreter
- Write the final equation for acceleration of body 1 in the same figure using latex interpreter

Project 12

By applying the Lagrange equation determine the acceleration of body with the mass m1. Assume: no sliding, non-stretchable cords and homogeneous wheels.
Data given:
mases: m1, m2, m3, m4
wheel radius: R, r
force moment: M



- Plot the mechanical system in Matlab
- Write Lagrangian's equation and final equations for kinetic and potential energies in the same figure using latex interpreter
- Write the final equation for acceleration of body 1 in the same figure using latex interpreter