EXAMINATION III: Force Analysis

A planar mechanism is given (see the table with the codes). The input numerical data with the dimensions of the mechanism for ten cases are given in the table. The height of the bar links is $h = 0.010$ m. The width and the height of the slider joints are $w_{Slider} = 0.050$ m and $h_{Slider} = 0.020$ m. All the links are homogeneous rectangular prisms with the depth $d = 0.001$ m.

The density of the material is $\rho_{Steel} = 8000$ kg/m^3 and the gravitational acceleration is $g = 9.807$ m/s^2.

The external force or moment applied on the last link is opposed to the motion of the link and has the value:

$|\mathbf{F}_{ext}| = 2000$ N if the last link has a translational motion or,

$|\mathbf{M}_{ext}| = 3000$ N·m if the last link has a rotational motion.

Determine the joint forces and the motor moment $\mathbf{M}_m$ required for the dynamic equilibrium of the considered mechanism for the input angle ϕ.

The examination should contain the following:

Inertia forces and moments

Newton-Euler method write-up

- sketches of the FBD for each link;
- equilibrium dynamical equations for each dyad (force and moment equations); explain how you calculate all the unknowns;
- MATLAB/Mathematica program.

Dyad method write-up

- structural analysis: the type of the dyads (RRR or RRT or RTR);
- sketches of the FBD for each dyad and the driver link;
- equilibrium dynamical equations for each dyad (force and moment equations); explain how you calculate all the unknowns;
- MATLAB/Mathematica program.

Contour method write-up

- contours of the mechanism;
- sketches of the FBD for each joint forces and the driver link;
- equilibrium dynamical equations for each joint forces (force and moment equations); explain how you calculate all the unknowns;
- MATLAB/Mathematica program.

Final results.

Undergraduate students: select two methods.