ME 6590 Multibody Dynamics
Homework #3

1. A two-body system is shown in each of the two figures. The orientations of the bodies are specified relative to the inertial frame \( R \) (absolute angles) using 3-2-1 body-fixed rotation sequences. The angles for \( B_1 \) and \( B_2 \) are \( \theta_{1i} \) and \( \theta_{2i} \) \((i = 1, 2, 3)\), respectively. The positions of the bodies are to be specified using relative coordinates. The position of body \( B_1 \) is given relative to \( R \) and the position of \( B_2 \) is given relative to body \( B_1 \) as shown in the lower figure. The vectors \( s_1 \) and \( s_2 \) represent translation vectors of the bodies. The position vectors \( r_1 \) and \( q_2 \) are fixed in \( B_1 \) and the position vector \( r_2 \) is fixed in \( B_2 \).

Find \( \left\{ a_{G_2} \right\} \) the inertial components of the acceleration of \( G_2 \) the mass-center of \( B_2 \). Express the results in matrix-vector form using body-fixed angular velocity components. As in Homework #2, use the components of \( \left\{ s_1 \right\}, \left\{ s_2' \right\}, \left\{ \dot{\theta}_{B_1} \right\}, \) and \( \left\{ \dot{\theta}_{B_2} \right\} \) as the generalized speeds.

2. Given the same set-up as above, find \( \left\{ a_{G_3} \right\} \) the inertial components of the acceleration of \( G_3 \) the mass-center of body 3 of the multibody system shown. Express the results in matrix-vector form using the body-fixed angular velocity components. As in Homework #2.1, use the components of \( \left\{ s_1 \right\}, \left\{ s_2' \right\}, \left\{ s_3' \right\}, \left\{ \dot{\theta}_{B_1} \right\}, \left\{ \dot{\theta}_{B_2} \right\}, \) and \( \left\{ \dot{\theta}_{B_3} \right\} \) as the generalized speeds.