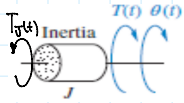
Rotational Mechanical System

Tuesday, 12 March 2024 7:51 am

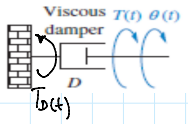
$\theta_{(t)}$ = angular displacement



$T_{J(t)} = Ja$

$T_{J(t)} = J\frac{d^2\theta_{(t)}}{dt}$ ①

$T_{J(s)} = Js^2\theta_{(s)}$ ②



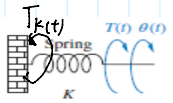
$T_{D(t)} = Dv$

$T_{D(t)} = D\frac{d\theta_{(t)}}{dt}$ ③

$T_{D(s)} = Ds\theta_{(s)}$ ④ } fixed damper

$T_{D(t)} = D\left[\dot{\theta}_1(t) - \dot{\theta}_2(t)\right]$ ⑤

$T_{D(s)} = Ds\left[\theta_{1(s)} - \theta_{2(s)}\right]$ ⑥ } free damper

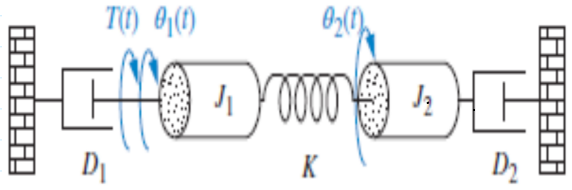


$T_{K(t)} = K\theta_{(t)}$ ⑦

$T_{K(s)} = K\theta_{(s)}$ ⑧ } fixed spring

$T_{K(t)} = K\left[\theta_1(t) - \theta_2(t)\right]$ ⑨

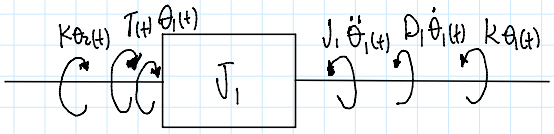
$T_{K(s)} = K\left[\theta_{1(s)} - \theta_{2(s)}\right]$ ⑩ } free spring



$J_1 = J_2 = D_1 = D_2 = K = 1$

$\frac{\theta_{(s)}}{T_{(s)}}$, $T_{J(s)}$, $T_{D(s)}$, $T_{K(s)}$

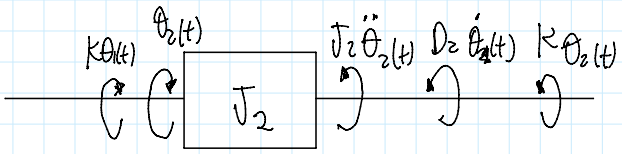
FBD ①



$T_{(t)} = J_1\ddot{\theta}_{1(t)} + D_1\dot{\theta}_{1(t)} + K\theta_{1(t)} - K\theta_{2(t)}$

$T_{(s)} = s^2\theta_{1(s)} + s\theta_{1(s)} + \theta_{1(s)} - \theta_{2(s)}$

$T_{(s)} = \theta_{1(s)}\left[s^2 + s + 1\right] - \theta_{2(s)}$

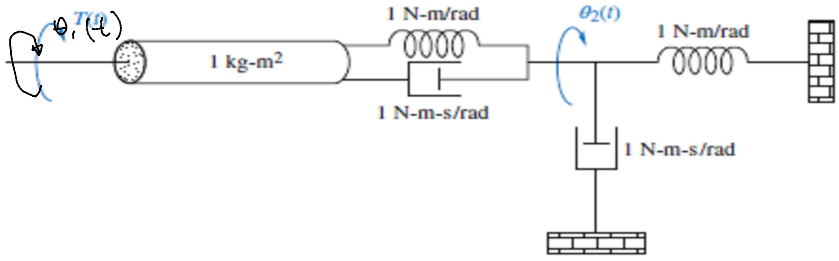


$0 = J_2\ddot{\theta}_{2(t)} + D_2\dot{\theta}_{2(t)} + K\theta_{2(t)} - K\theta_{1(t)}$

$0 = s^2\theta_{2(s)} + s\theta_{2(s)} + \theta_{2(s)} - \theta_{1(s)}$

$0 = \theta_{2(s)}\left[s^2 + s + 1\right] - \theta_{1(s)}$

PROBLEM: Find the transfer function, $G(s) = \theta_2(s)/T(s)$, for the rotational mechanical system shown in Figure 2.26.



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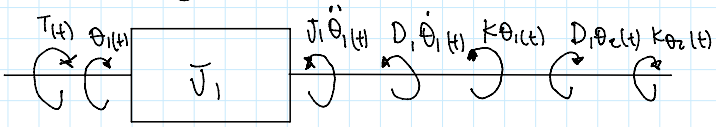
FBD ①



FBD ②