question 37

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1 Problem

2 Solution
- making an equvalent system
- writing equations of motion

Problem Statement

For the rotational system shown in figure P2.23,write the equations of motion from which the transfer function

$$G(s) = \frac{\theta_1(s)}{T(s)} \tag{1.1}$$

can be found

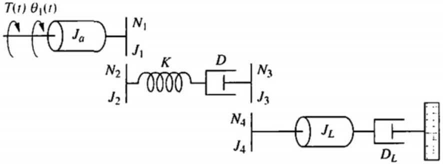
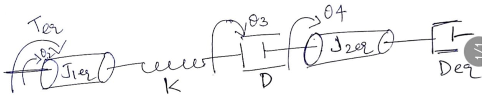


FIGURE P2.23

Figure

equivalent system

As there is spring and the viscous damper connected So reflecting the above and the below impedance's on to the middle system i.e reflect all impedance's on the right to the viscous damper and reflect all impudence's and torques on the left to the spring and obtain the following equivalent system:



Figure

equivalent system

where these are obtained by reflecting as above said by using gear analysis

$$J_{1eq} = J_2 + (J_a + J_1)(\frac{N_2}{N_1})^2; \tag{2.1}$$

$$J_{2eq} = J_3 + (J_L + J_4)(\frac{N_3}{N_4})^2; \tag{2.2}$$

$$D_{eq} = D_L(\frac{N_3}{N_4})^2; \tag{2.3}$$

$$\theta_2(s) = \theta_1(s)(\frac{N_1}{N_2}) \tag{2.4}$$

equations of motion

By considering the mass J_1 and applying the super position theorem to find the torques acting on it:

$$(J_{1eq}s^2 + K)\theta_2(s) - K\theta_3(s) = T_{eq}(s) \tag{2.5}$$

By considering the mass J_2 and applying the super position theorem to find the torques acting on it:

$$-Ds\theta_3(s) + [J_{2eq}s^2 + (D + D_{eq})s]\theta_4(s) = 0 \tag{2.6}$$

writing equation for the spring and viscous damper

By assuming imaginary mass between the spring and damper we can write the equation of motion on that.

$$-K\theta_2(s) + (Ds + K)\theta_3(s) - Ds\theta_4(s) = 0 \tag{2.7}$$

Here, we will not find the mass term because as it is imaginary mass that is of zero weight.
These are the equations of motion for finding the transfer function