

Homework

Moments and Gears

1. Compute the moment caused by a 10 N force, bearing 22° relative to the x-axis acting at a distance of 2 m, bearing 44° relative to the x-axis. Draw a picture of both the force and position vector.

Two gears in mesh

torque ratio

$$\frac{M_L}{M_m} = \frac{Z_2}{Z_1}$$

where M_L is the load moment (torque), M_m is the motor moment (torque), Z_2 is the number of teeth on the gear connected to the load, and Z_1 is the number of teeth of the gear connected to the motor.

speed ratio

$$\frac{\omega_L}{\omega_m} = \frac{Z_1}{Z_2}$$

where is ω_L the output speed, is ω_m the motor speed, Z_2 is the number of teeth on the gear connected to the load, and Z_1 is the number of teeth of the gear connected to the motor.

Multiple gear stages

torque ratio

$$\frac{M_L}{M_m} = \left(\frac{Z_2}{Z_1}\right)\left(\frac{Z_4}{Z_3}\right)\dots$$

where M_L is the load moment (torque), M_m is the motor moment (torque), Z_4 is the number of teeth on the gear connected to the load, Z_1 is the number of teeth of the gear connected to the motor, Z_3 is the number of teeth on the gear meshing with the output gear, and Z_2 is the number of teeth on the gear meshing with the motor gear.

speed ratio

$$\frac{\omega_L}{\omega_m} = \left(\frac{Z_1}{Z_2}\right)\left(\frac{Z_3}{Z_4}\right)\dots$$

where is ω_L the output speed, is ω_m the motor speed, Z_4 is the number of teeth on the gear connected to the load, Z_1 is the number of teeth of the gear connected to the motor, Z_3 is the number of teeth on the gear meshing with the output gear, and Z_2 is the number of teeth on the gear meshing with the motor gear.

2. For an input gear with 10 teeth meshing with an output gear of 30 teeth, what is the torque ratio? What is the speed ratio?
3. A 20 tooth gear meshes with a 40 tooth gear. On the same shaft as the 40 tooth gear, a second 20 tooth gear meshes with a 60 tooth gear. What is the torque ratio? What is the speed ratio?