Sizing of Motor

Moment of Inertia of Roller1

Assuming the Roller as a cylinder with radius r and length l .
Density of mild steel =7860 kg/m^3
Radius of Roller1 = 20 mm
Length of Roller1 = 109 mm

$J_{roller1} = \rho\pi r^4 l$

$= 1.37 \times 10^{-4}$ kg m^2

Moment of Inertia of Roller2

Assuming the Roller as a cylinder with radius r and length l .
Density of mild steel =7860 kg/m^3
Radius of Roller2 = 22.5 mm
Length of Roller2 = 80 mm

$J_{roller2} = \rho\pi r^4 l$

$= 1.61 \times 10^{-4}$ kg m^2

Moment of Inertia of Shaft 1

Assuming the Shaft as a cylinder with radius r and length l .
Density of mild steel =7860 kg/m^3
Radius of Shaft1 = 6.5 mm
Length of Shaft1 = 61 cm

$J_{shaft\ 1} = \rho\pi r^4 l$

$= 2.69 \times 10^{-5}$ kg m^2

Moment of Inertia of Shaft 2

Assuming the Shaft as a cylinder with radius r and length l .
Density of mild steel =7860 kg/m^3
Radius of Shaft2 = 6.5 mm
Length of Shaft2 = 20.7 cm

$J_{shaft\ 2} = \rho\pi r^4 l$

$= 9.12 \times 10^{-6}$ kg m^2

Moment of Inertia of Shaft 3

Assuming the Shaft as a cylinder with radius r and length l .
Density of mild steel =7860 kg/m^3
Radius of Shaft3 = 6.5 mm
Length of Shaft3 = 20.4 cm

$J_{shaft\ 3} = \rho\pi r^4 l$

$= 8.99 \times 10^{-6}$ kg m^2

Moment of Inertia of Shaft 4

Assuming the Shaft as a cylinder with radius r and length l .
Density of mild steel =7860 kg/m^3
Radius of Shaft4 = 6.5 mm
Length of Shaft4 = 15.1 cm

$J_{shaft\ 4} = \rho\pi r^4 l$

$= 6.65 \times 10^{-6}$ kg m^2

Moment of Inertia of Sprocket 1

Assuming the Sprocket as a cylinder with radius r and length l .
Density of mild steel =7860 kg/m^3
Radius of Sprocket1 = 12.9 mm
Length of Sprocket1 = 20.3 mm

$J_{sprocket\ 1} = \rho\pi r^4 l$

$= 1.57 \times 10^{-5}$ kg m^2

Moment of Inertia of Sprocket 2

Assuming the Sprocket as a cylinder with radius r and length l .
Density of mild steel =7860 kg/m^3
Radius of Sprocket2 = 17.6 mm
Length of Sprocket2 = 39 mm

$J_{sprocket\ 2} = \rho\pi r^4 l$

$= 9.24 \times 10^{-5}$ kg m^2

Moment of Inertia of Spring

Assuming the spring is uniformly distributed along axis
Radius of thickness of spring = 3 mm
Radius of spring = 45 mm
Length of spring =150 mm

$J_{spring} = \frac{\rho\pi r^2 R^2 l}{8}$

$= 8.44 \times 10^{-6}$ kg m^2

Torque Calculation

$$J_{load} = J_{shaft1} + J_{shaft2} + J_{shaft3} + J_{shaft4} + J_{roller2} + J_{roller1} + 2 \times J_{sprocket1} + 2 \times J_{sprocket1} + 2 \times J_{spring}$$

$= 5.82 \times 10^{-4}$ kg m^2

$$T_a = \frac{J_{Load} \times V}{9.55 \times t}$$

$= 0.12$ Nm

Min Torque Needed = $T_a \times$ FOS

$= 0.12 \times 2$

$= 0.24$ Nm