Ex 3) Motors with Gears

- **In Ex 1) and 2), compute the torque, maximum speed and power when they are used with gears**
  - **For in-wheel motor, assume 6:1 reduction ratio**
  - **For rotary indexing, assume 50:1 reduction ratio**

  Neglect the inertia values of motors (for now).

For in-wheel motor,

$$J_{eff} = \frac{J_w + (M+m)r^2}{N^2} = \frac{11}{36} = 0.3056 \ kg \cdot m^2$$

$$T = J_{eff} \cdot N\alpha = 0.3056 \times 6 \times 23.15 = 42.44 \ N \cdot m$$

$$\omega_{max} = 2653 \times 6 = 15918 \ rpm$$

$$P_{av} = \frac{1}{6}\left(\frac{1}{2} J_{eff} \omega^2\right) = \frac{1}{12} \times 0.3056 \times 138.91^2 = \boxed{17.68 \ kW}$$

(ω in rad/s for 100 km/h)

For rotary index:

$$J_{eff} = \frac{J}{50^2} = \frac{14.6}{2500} = 0.0058 \ kg \cdot m^2$$

$$T = \frac{61.32}{50} = 1.23 \ N \cdot m$$

$$\omega_{max} = 50 \times 20.053 \ rpm = 1003 \ rpm$$

$$P_{av} = \boxed{64.39 \ kW} \quad \text{(same as before)}$$