HW No. 5

The following table contains the motor specifications for the model FA-130RA-18100 Mabichi DC motor that comes with the “Tamiza 4 speed Crank Axle Gearbox and Motor”, which you will find in your bag of parts for the design project.

<table>
<thead>
<tr>
<th>MODEL</th>
<th>VOLTAGE</th>
<th>NO LOAD</th>
<th>AT MAXIMUM EFFICIENCY</th>
<th>STALL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OPERATING RANGE</td>
<td>NOMINAL</td>
<td>SPEED</td>
<td>CURRENT</td>
</tr>
<tr>
<td>FA-130RA</td>
<td>2270</td>
<td>1.5 - 3.0</td>
<td>1.5</td>
<td>9100</td>
</tr>
<tr>
<td>18100</td>
<td>1.5 - 3.0</td>
<td>3</td>
<td>12300</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Please use the specifications for model 18100 to answer the motor problems below.

**Motor Problems:**

1. Assume the motor curve for the Mabichi DC motor is linear. Sketch the motor curve (torque versus angular speed). Be sure to label the axes.

2. Show that the linear motor curve is

   \[ T_m = -\frac{T_{STALL}}{\omega_{NOLOAD}} \omega_m + T_{STALL} \]

3. How fast will the motor shaft spin if it is loaded by a torque of 1.20 mN-m? What is the power produced by the motor (in Watts) at this shaft speed?

4. Show that the maximum power produced by the motor is equal to

   \[ 0.25T_{STALL} \omega_{NOLOAD} \]

   which occurs at an angular speed of \( 0.5\omega_{NOLOAD} \).

**Gear Problems:** (Read Section 13.7 in Chapter 13.)

All the following problems are on p. 283.

Do Problems 21, 23, 24, and 25.