HOMEWORK 5

Prepared by: Musab Çağrı Uğurlu (D-110)
Assignment Date: December 11, 2014
Due Date: December 18, 2014 (submit to D-110 until 17:00)

Note: Do not forget to write your list number on top of the 1st page of your Homework!!!

PROBLEM 1

Consider the gear train shown above. Determine the speed and direction of the output link 8 when link-2 rotates at 15 rpm in (+) direction about x-axis and link-4 rotates at 20 rpm in (-) direction about x-axis.

Note: This homework has a half weight with respect to others.
Solution:
Given, \( \omega_{12} = 15 \text{ rpm} \) and \( \omega_{14} = -20 \text{ rpm} \)

Then,

\[
\frac{\omega_{13}}{\omega_{12}} = -\frac{N_2}{N_3} \Rightarrow \frac{\omega_{13}}{15} = -\frac{15}{50} \Rightarrow \omega_{13} = -\frac{9}{2} \text{ rpm}
\]

\[
\frac{\omega_{15}}{\omega_{14}} = -\frac{N_4}{N_5} \Rightarrow \frac{\omega_{15}}{-20} = -\frac{35}{25} \Rightarrow \omega_{15} = 28 \text{ rpm}
\]

For planetary gear train where link 3 is arm (gears 3, 5, 6, 7)

\[
\frac{\omega_{17} - \omega_{13}}{\omega_{15} - \omega_{13}} = \left(-\frac{N_5'}{N_6}\right) \left(-\frac{N_6}{N_7}\right) \Rightarrow \frac{\omega_{17} + \frac{9}{2}}{28 + \frac{9}{2}} = \left(-\frac{90}{25}\right) \left(-\frac{25}{60}\right) \Rightarrow \omega_{17} = \frac{177}{4} \text{ rpm}
\]

For planetary gear train where link 3 is arm (gears 7, 8)

\[
\frac{\omega_{18} - \omega_{13}}{\omega_{17} - \omega_{13}} = -\frac{N_7}{N_8} \Rightarrow \frac{\omega_{18} + \frac{9}{2}}{177 + \frac{9}{2}} = -\frac{140}{120} \Rightarrow \omega_{18} = -\frac{491}{8} \text{ rpm}
\]

Therefore, output link 8 rotates at \( \omega_8 = 61.375 \text{ rpm} \) in (\( -\)) direction about x-axis.