Chapter 6 & 10 HW Hints

NOTE: I am combining the Chapter 6 HW problems with the Chapter 10 HW problems. This combined assignment is due on Monday, April 5.

Problem 6.1: The center-to-center distance is the sum of the two pitch circle radii. To mesh, the gears must have the same diametral pitch. These two facts are enough to solve for the diametral pitch P.

Problem 6.2: This should be fairly straightforward using the relationships of text Section 6.1.

Problem 6.6: The pitch diameter is twice the radius R of the pitch circle. This problem is also easy—note that you must get an *integral* number of teeth N for each gear.

Problem 6.13: Given diametral pitch P, the addendum and dedendum data can be found in Table 6.2. Although the lengths of approach and recess can be calculated from text equations (6.10) and (6.11), you should make a drawing similar to Figures 6.8 and 6.9 (don't need to draw tooth profiles) from which you can measure the lengths of approach and recess to compare. All the other quantities can be found at various places in Chapter 6.

One result: I found the *contact ratio* to be

$$m_c = \frac{CD}{p_b} = 1.6472 \text{ (average number of teeth in contact)}$$

Problem 10.4: Calculate the *gear ratio* n for each forward and reverse gear in this transmission. Recall that gear ratio $n = \omega_{in}/\omega_{out}$ and $n > 1$ for a speed reducing transmission.

NOTE: There is a mistake in this problem; the last row in the table in Figure 10.2 is wrong. The operation of the "reverse" gear is the following: in "reverse" the "reverse idler" assembly slides to the left, and gear 6 engages gear 11, and gear 9 engages gear 10 (gears 10 and 11 are fixed to the same shaft). Thus the "Drive" is 2-3-6-11-10-9, which is different that indicated in the table. The addition of the reverse idler changes the direction of rotation of the output shaft.

Starr Problem 1: Perform the exercise "suggested" in the last sentence on text page 313, *i.e.* "As an exercise, it is suggested that you seek out a suitable set of (U.S. Customary) diametral pitches for each pair of gears shown in Fig. 10.4 so that the first and last gears will have the same axis of rotation with all gears properly engaged."

Use the definition of diametral pitch P (text equation (6.1)) and the uppermost table of text Table 6.1. I found that there are a number of possible solutions: both "coarse" and "fine." You do not need to find all solutions, but it's pretty easy to do.

Starr Problem 2: Design an overdrive unit similar to Example 10.6 so that the percentage reduction in engine speed is 25% and the ring gear has a pitch diameter of approximately 6 inches.

- Select appropriate diametral pitch, numbers of teeth for all gears, *etc.*
- Make a full-size drawing of your final unit showing the pitch circles of all gears (use three planetary gears in your drawing).
- Assuming the 20° full-depth AGMA tooth standard, find the *contact ratio* m_c for the sun/planet gear mesh (it should be roughly $m_c \approx 1.5$).