The graphic in figure 1 defines many important terms for spur gears. These terms are valuable for the discussion and analysis of gears.

Pitch circle - Theoretical circle on which all calculations are based. The diameter of the pitch circle is the pitch diameter \(d\).

Circular pitch \(p\) - Related to the pitch diameter, this is the arc length between identical points on adjacent gear teeth, along the pitch circle. It is related to the pitch diameter as follows:

\[
p = \frac{\pi d}{N}
\]  

where \(N\) is the number of teeth in the gear. Another useful term, which is frequently used in specifying
gears is the **diametral pitch** (P), which is defined as:

\[ P = \frac{N}{d} \]  

(2)

The diametral pitch and circular pitch are related by \( Pp = \pi \). **Two gears must have the same pitch, and consequently, the same diametral pitch, in order to mesh.**

**Clearance (f)** - The clearance prevents the teeth of one gear from riding into bottom part of mating gear (jamming).

**Clearance circle** - This circle is tangent to the **addendum circle** of the mating gear.

**Face width (b)** - The face width should be the same for all mating gears. Typically:

\[ \frac{9}{P} \leq b \leq \frac{13}{P} \]  

(3)

**Whole depth (h)** - This can be defined in two ways:

\[ h = a + b_d \]

(4)

\[ h = h_k + f \]

(5)

**Tooth thickness (t)** - The tooth thickness measured at the pitch circle is equal to the width of space.

Below is a table with common dimensions of gear teeth, based on the diametral pitch (P). The angles are the pressure angles of the gear, which is discussed on the next page.

<table>
<thead>
<tr>
<th>Item</th>
<th>20° full depth</th>
<th>20° stub</th>
<th>25° full depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addendum ( a )</td>
<td>( 1/P )</td>
<td>0.8/P</td>
<td>1/P</td>
</tr>
<tr>
<td>Dedendum ( b_d )</td>
<td>1.25/P</td>
<td>1/P</td>
<td>1.25/P</td>
</tr>
<tr>
<td>Clearance ( f )</td>
<td>0.25/P</td>
<td>0.2/P</td>
<td>0.25/P</td>
</tr>
<tr>
<td>Working depth ( h_k )</td>
<td>2/P</td>
<td>1.6/P</td>
<td>2/P</td>
</tr>
<tr>
<td>Whole depth ( h )</td>
<td>2.25/P</td>
<td>1.8/P</td>
<td>2.25/P</td>
</tr>
<tr>
<td>Tooth thickness ( t )</td>
<td>1.571/P</td>
<td>1.571/P</td>
<td>1.571/P</td>
</tr>
</tbody>
</table>
There are also several important definitions for two mating gears, shown in figure 2.

**Pitch point** (P) - Point at which gears contact. Pitch circles are mutually tangent at this point, as indicated by line a-b.

**Pressure angle** (φ) - The angle at which the resultant force between the two gears acts. The pressure angle is constant as the gears rotate for involute gears. This is represented by line c-d, the pressure line or line of action. The pressure angle should be the same for mating gears.

**Center distance** (c) - The distance between the centers of two gears in a mesh. This is defined as:

\[
c = r_1 + r_2 = \frac{N_1 + N_2}{2P}
\]

where \( r_i \) is the pitch radius and \( P \) is the same for both gears.

**Base radius** (\( r_{b1} \)) - The base radius is the radius of the base circle or clearance circle. The line representing it in figure 2 is perpendicular to the pressure line where the pressure line is tangent to the base circle. Therefore, the base circle radius can be defined with respect to the pitch radius (\( r_i \)):

\[
r_b = r_i \cos \phi
\]

For review purposes, both figures on this handout are given on the next page, except the labels are removed, so that they can be filled in independently. **You will be quizzed on this information.**

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Figure 2: Involute gear teeth contact form and pressure angle
Figure 3: Figures for review