9.3.1 Design Specification Questions

These questions are usually pretty straightforward. Let's get right into it!

9.3.1.1 Spur Gears **using Mott*

In a question involving a spur gear pair, you will be given the following:

- Diametral Pitch (P_d)[46] [teeth/inch]
- Pressure Angle (ϕ)
- Number of teeth for both the Pinion (N_P) and Gear (N_G)

In return, you will have to specify the following:

- Pitch Diameter for Pinion (D_P) and Gear (D_G)
- Circular Pitch (p)
- Addendum (a)
- Dedendum (b)
- Clearance (c)
- Outside Diameters for Pinion (D_{oP}) and Gear (D_{oG})
- Root Diameters for Pinion (D_{RP}) and Gear (D_{RG})
- Whole Depth (h_t)
- Working Depth (h_k)
- Tooth Thickness (t)
- Center Distance (C)
- Base Circle Diameter for Pinion (D_{bP}) and Gear (D_{bG})

I know they are a lot of things to calculate, but the calculator does all of these in 1 click. All units are generally in inches[47]. Anyways, let's begin.

1. **Start by using your given information to calculate the pitch diameters.**[48]

$$D_P = \frac{N_p}{P_d}$$

$$D_G = \frac{N_G}{P_d}$$

[46] Same for both gears

[47] If you are given module (m) in mm instead of P_d, convert using $P_d = \frac{25.4}{m}$

[48] You might also be given one of the diameters in some circumstances. In that case, solve for diametral pitch

2. **Calculate the circular pitch using any of the equations below.**

$$p = \frac{\pi}{P_d}$$
$$p = \pi \frac{D_P}{N_P}$$
$$p = \pi \frac{D_G}{N_G}$$

3. **Calculate the Addendum, Dedendum, and Clearance.**

$$a = \frac{1}{P_d}$$

For Coarse Pitch ($P_d < 20$ teeth/in):

$$b = \frac{1.25}{P_d}$$
$$c = \frac{0.25}{P_d}$$

For Fine Pitch ($P_d > 20$ teeth/in):

$$b = \frac{1.2}{P_d} + 0.002$$
$$c = \frac{0.2}{P_d} + 0.002$$

4. **Find Outside Diameters.**

$$D_{oP} = \frac{N_P + 2}{P_d}$$
$$D_{oG} = \frac{N_G + 2}{P_d}$$

5. **Calculate Root Diameters.**

$$D_{RP} = D_P - 2b$$
$$D_{RG} = D_G - 2b$$

6. **Calculate Whole Depth and Working Depth.**

$$h_t = a + b$$
$$h_k = 2a$$

7. **Calculate Tooth Thickness.**

$$t = \frac{\pi}{2P_d}$$

8. **Calculate Center Distance.**

$$C = \frac{N_G + N_P}{2P_d}$$

9. **Finally, find Base Circle Diameter**

$$D_{bP} = D_P \ cos(\phi)$$
$$D_{bG} = D_G \ cos(\phi)$$

10. **You're done!**